

FIG. 1



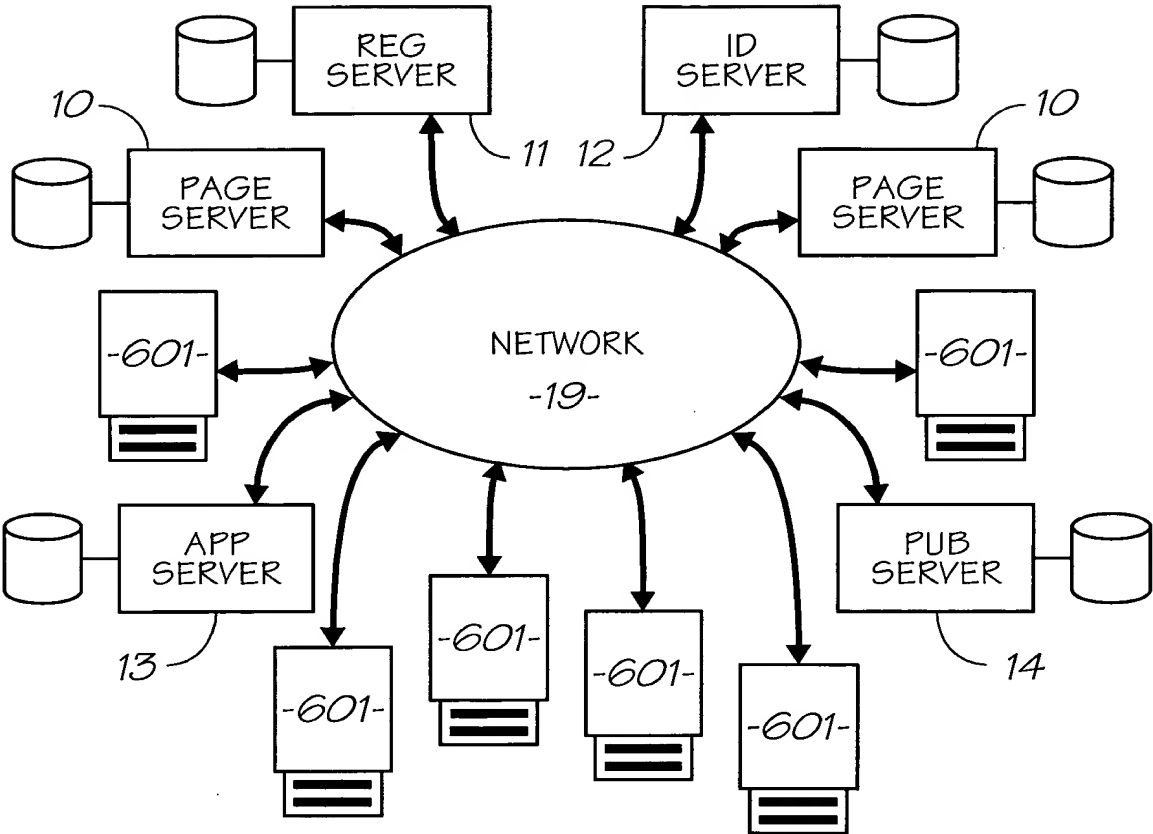


FIG. 3

0954501 5254560

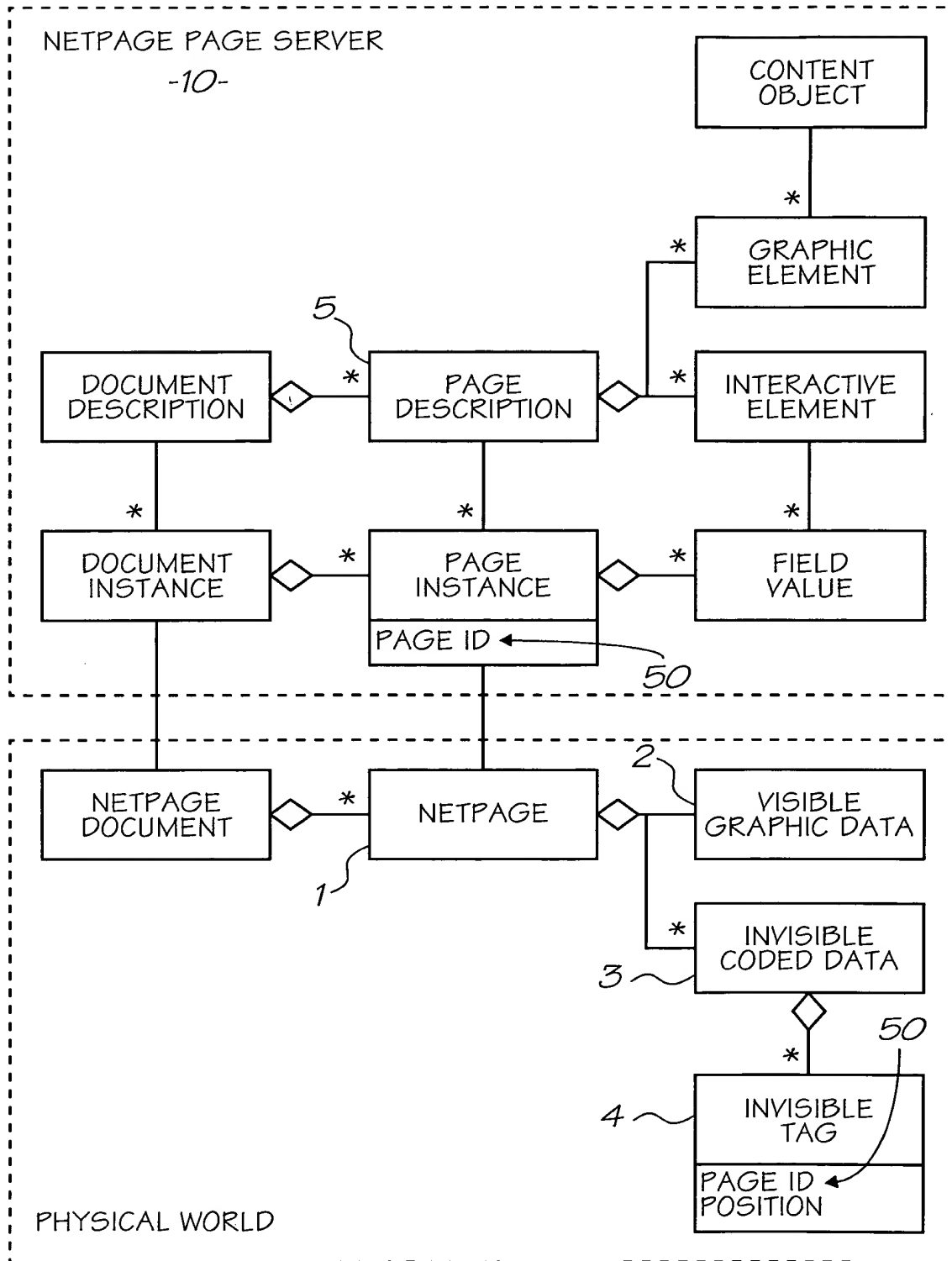


FIG. 4



FIG. 5



FIG. 6

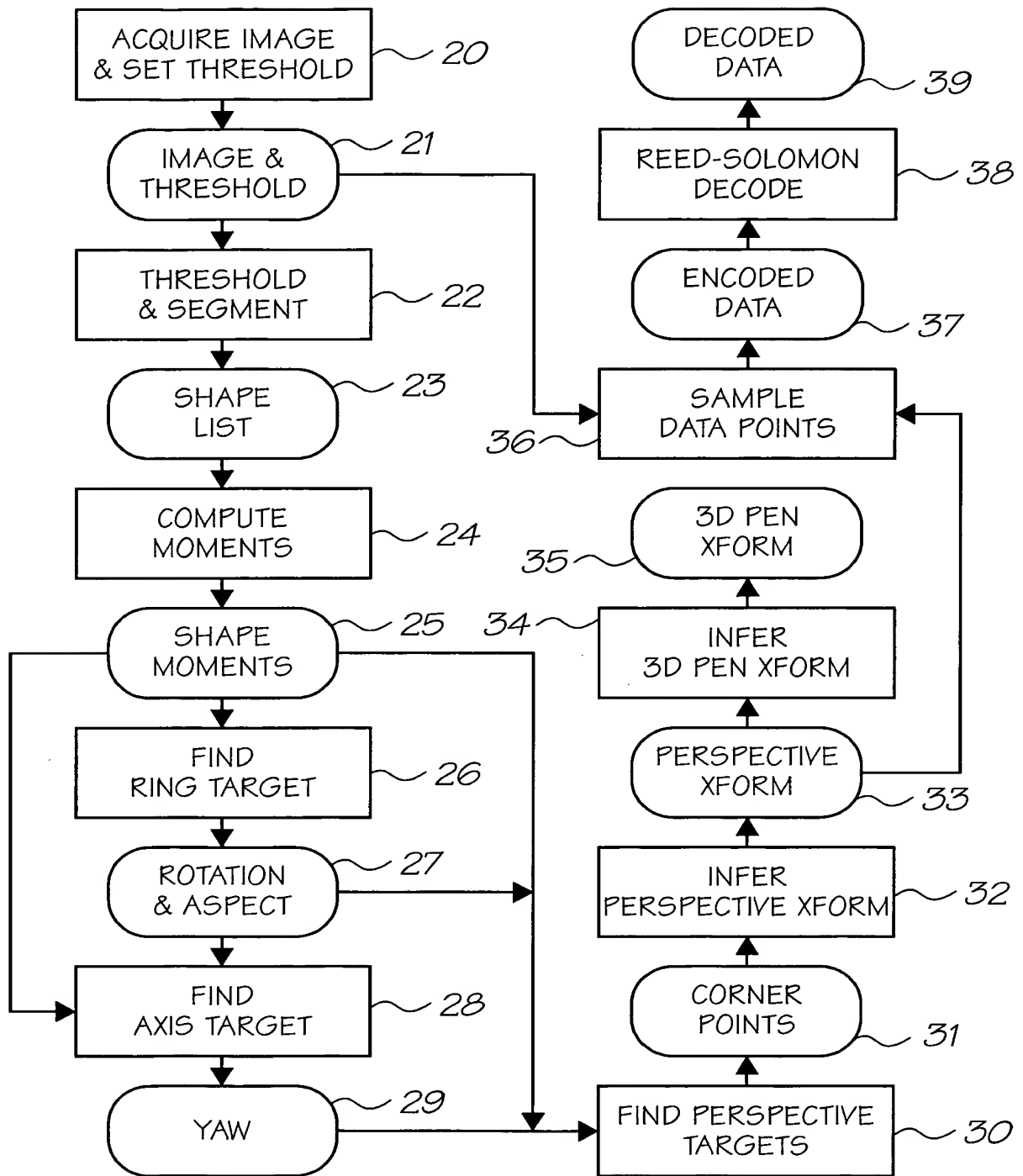


FIG. 7



FIG. 8

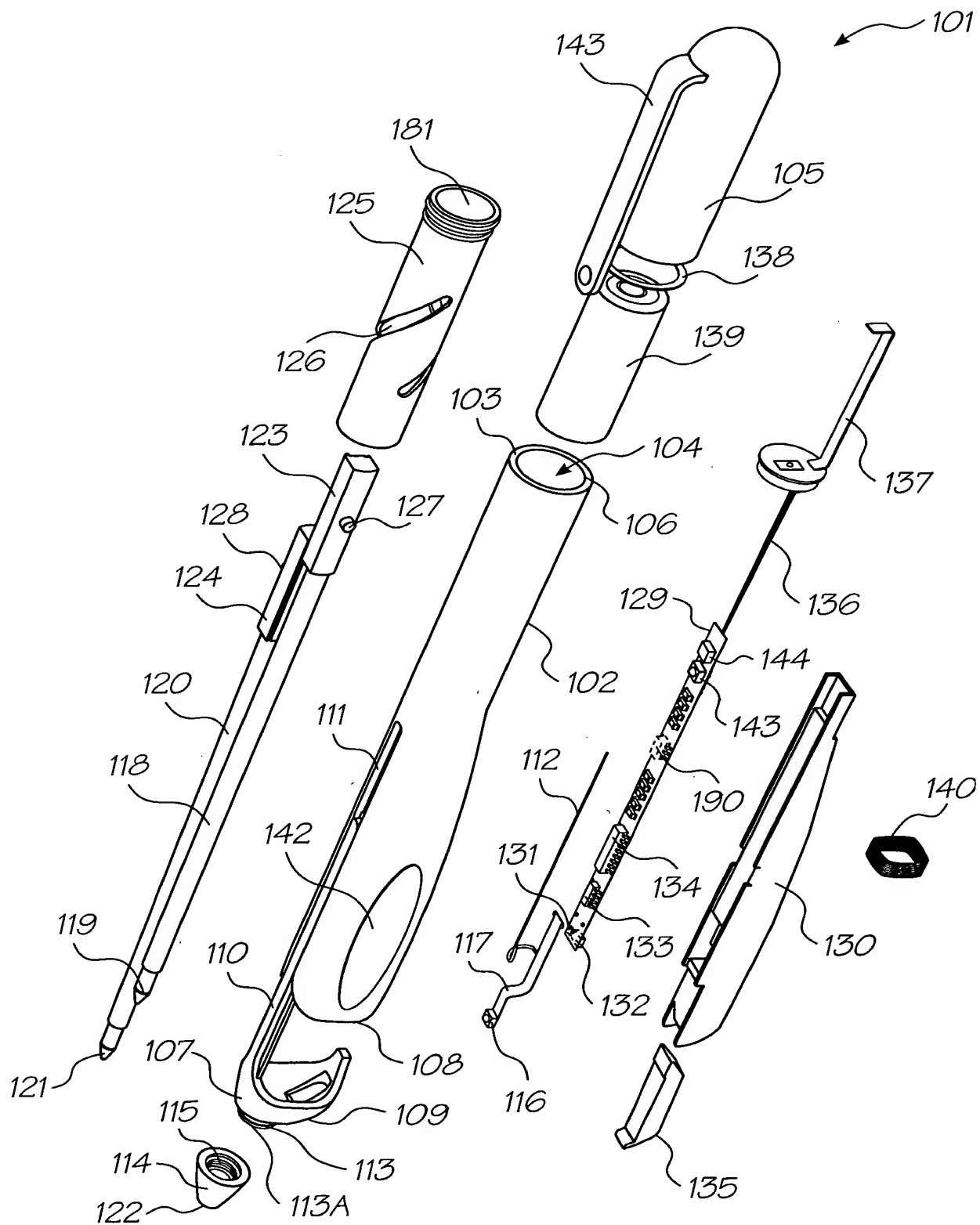


FIG. 9



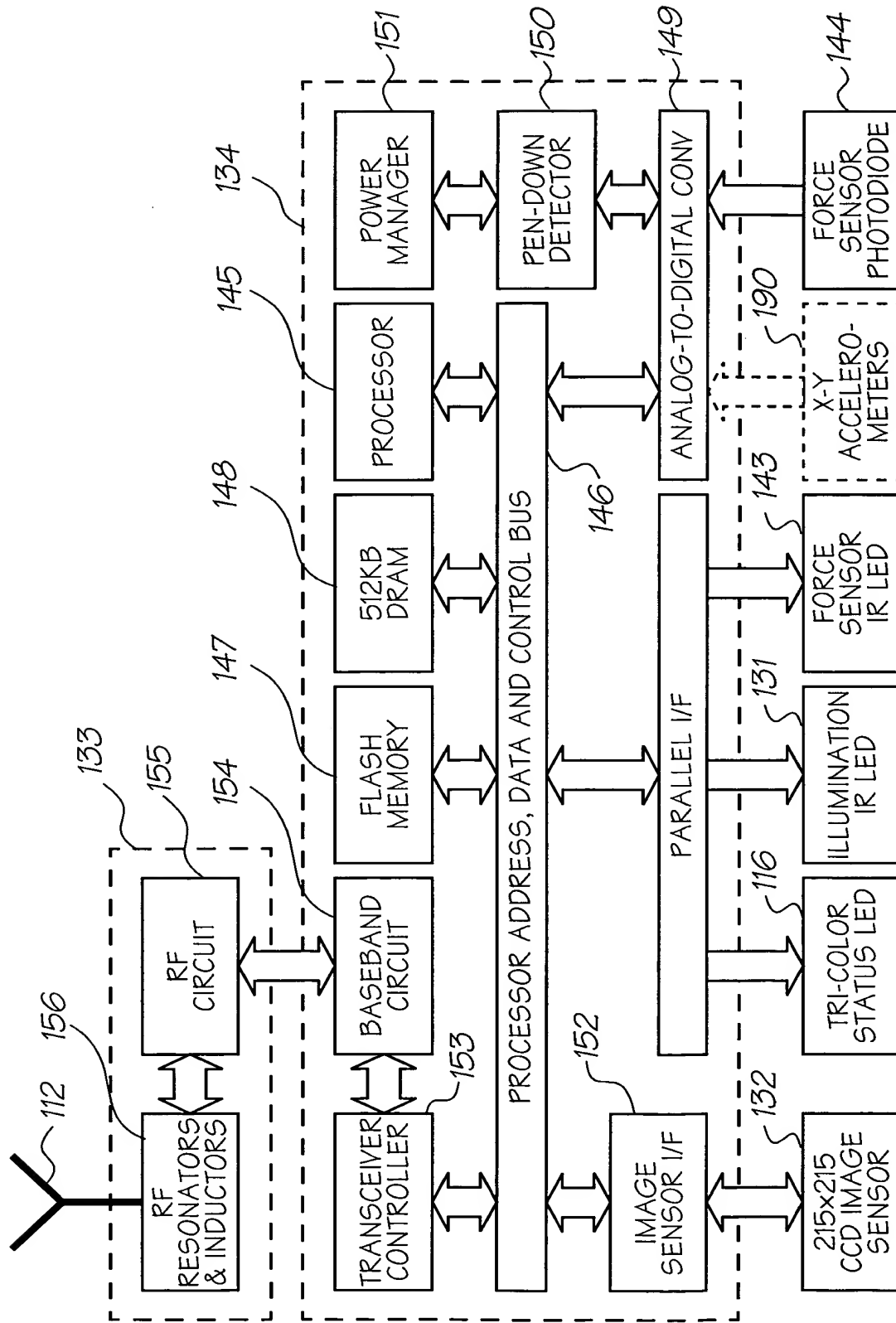


FIG. 10

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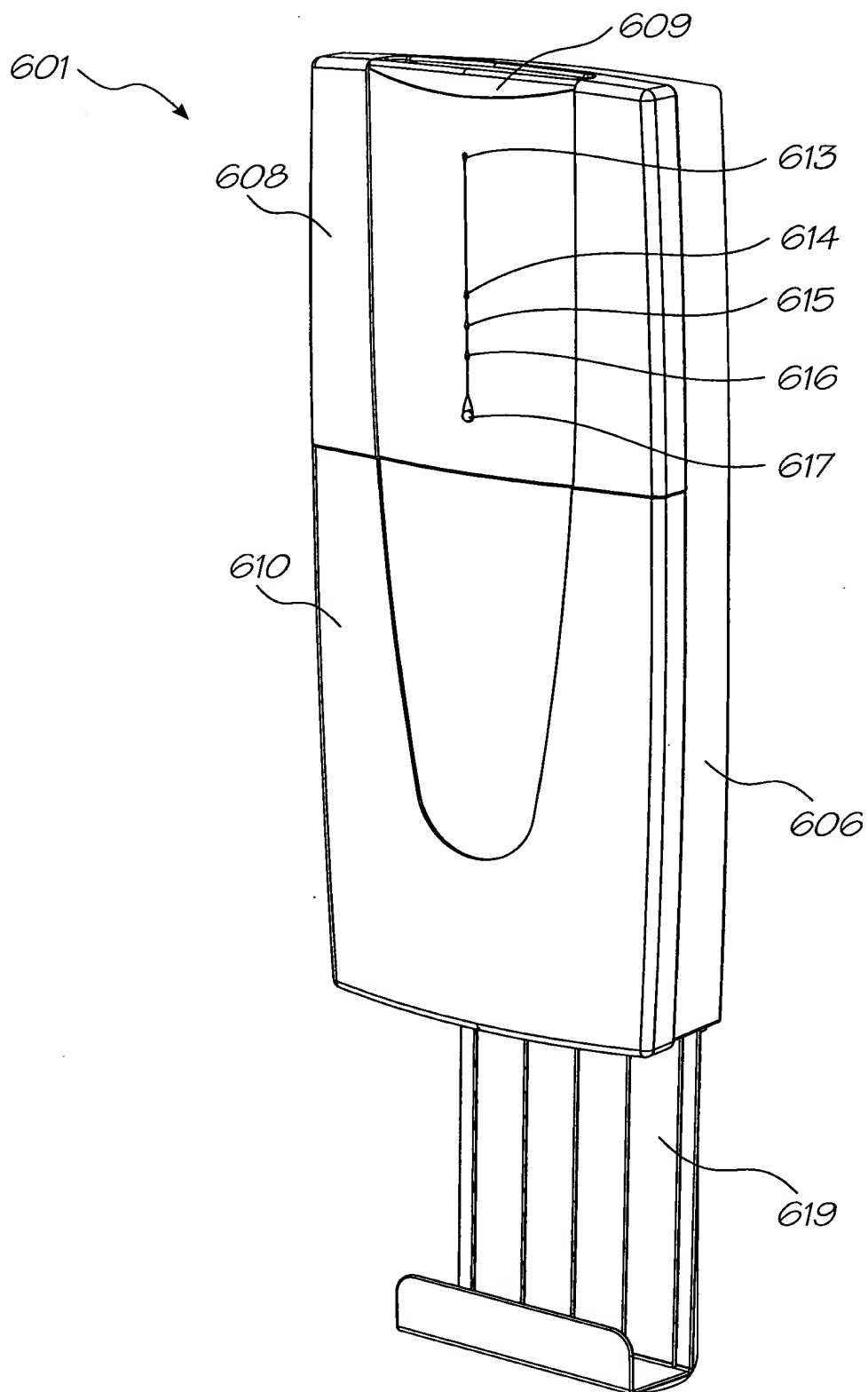


FIG. 11

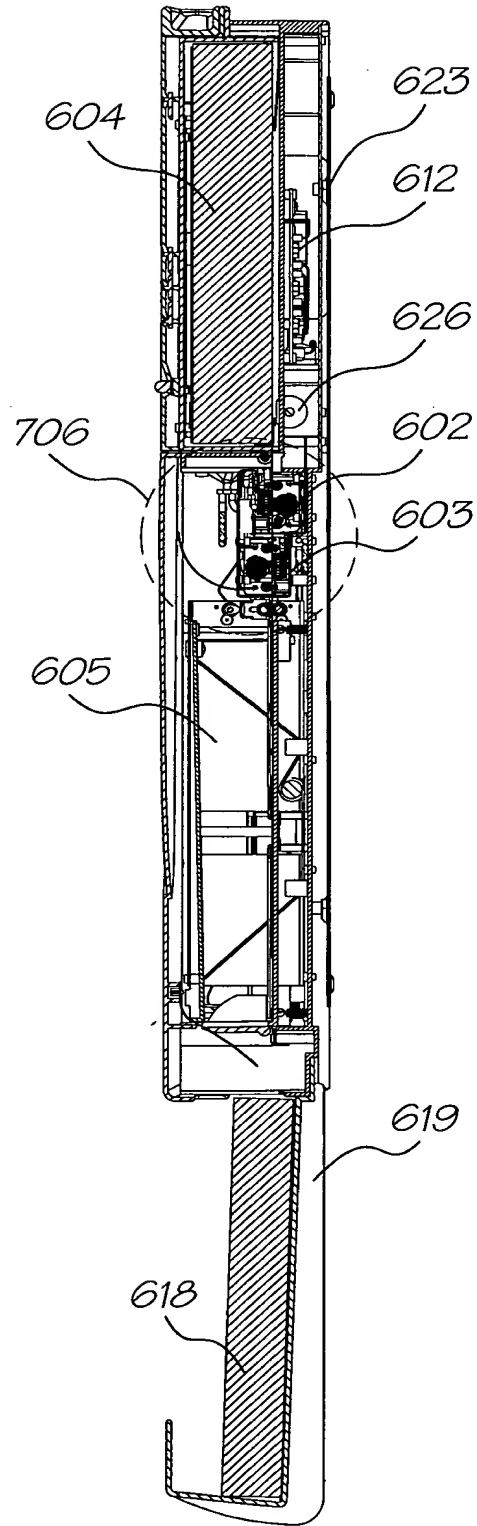


FIG. 12

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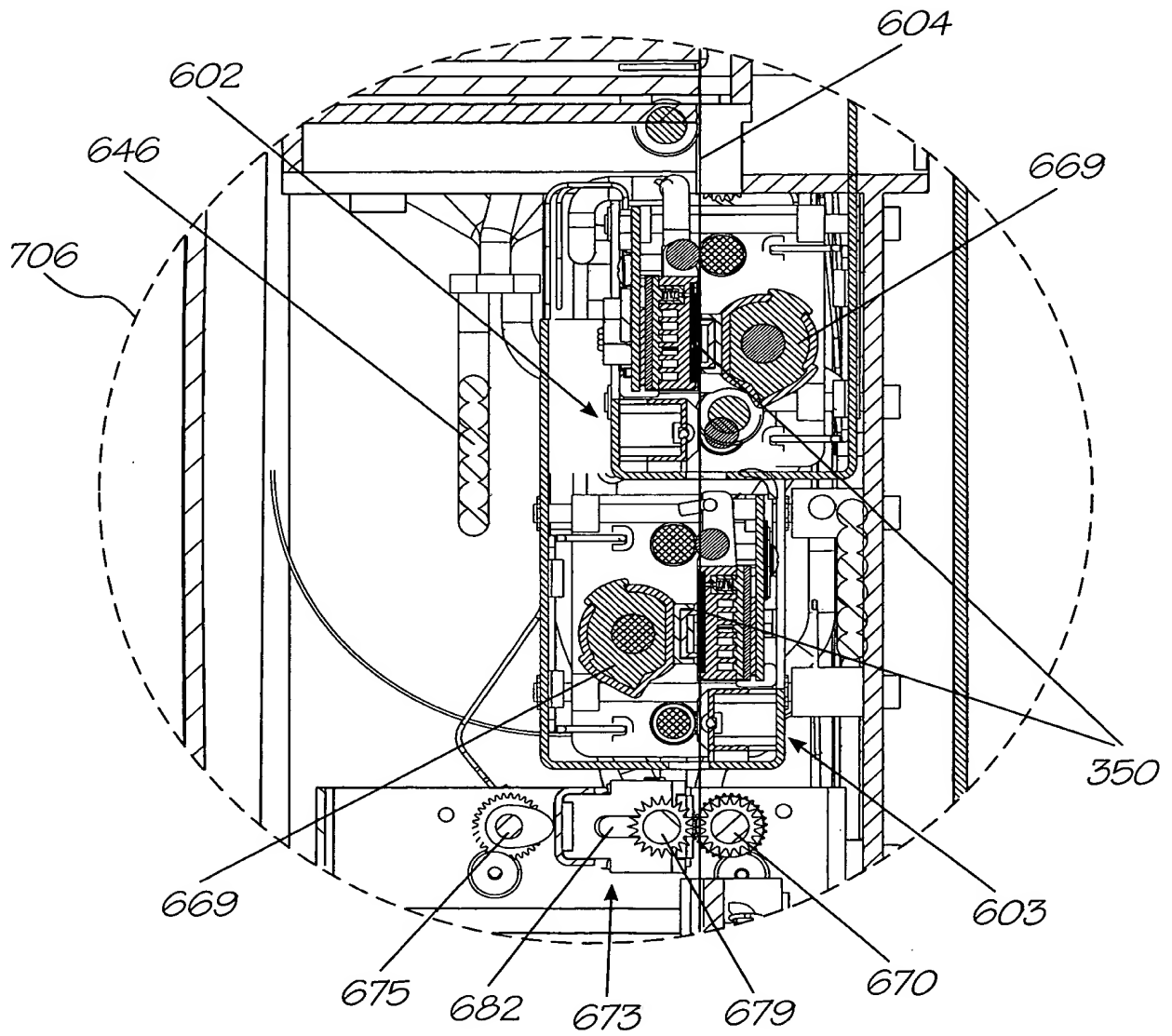


FIG. 12a

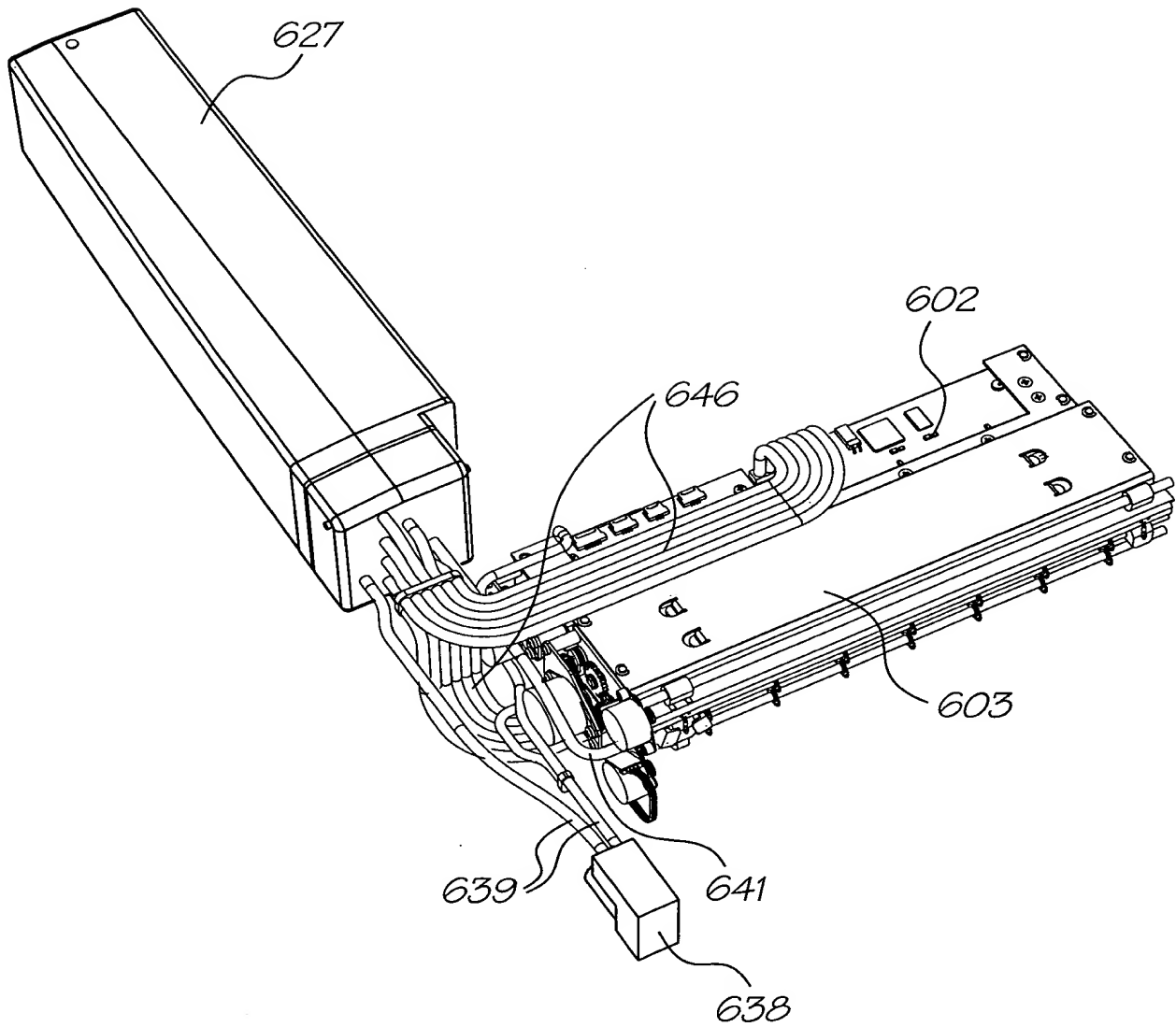


FIG. 13

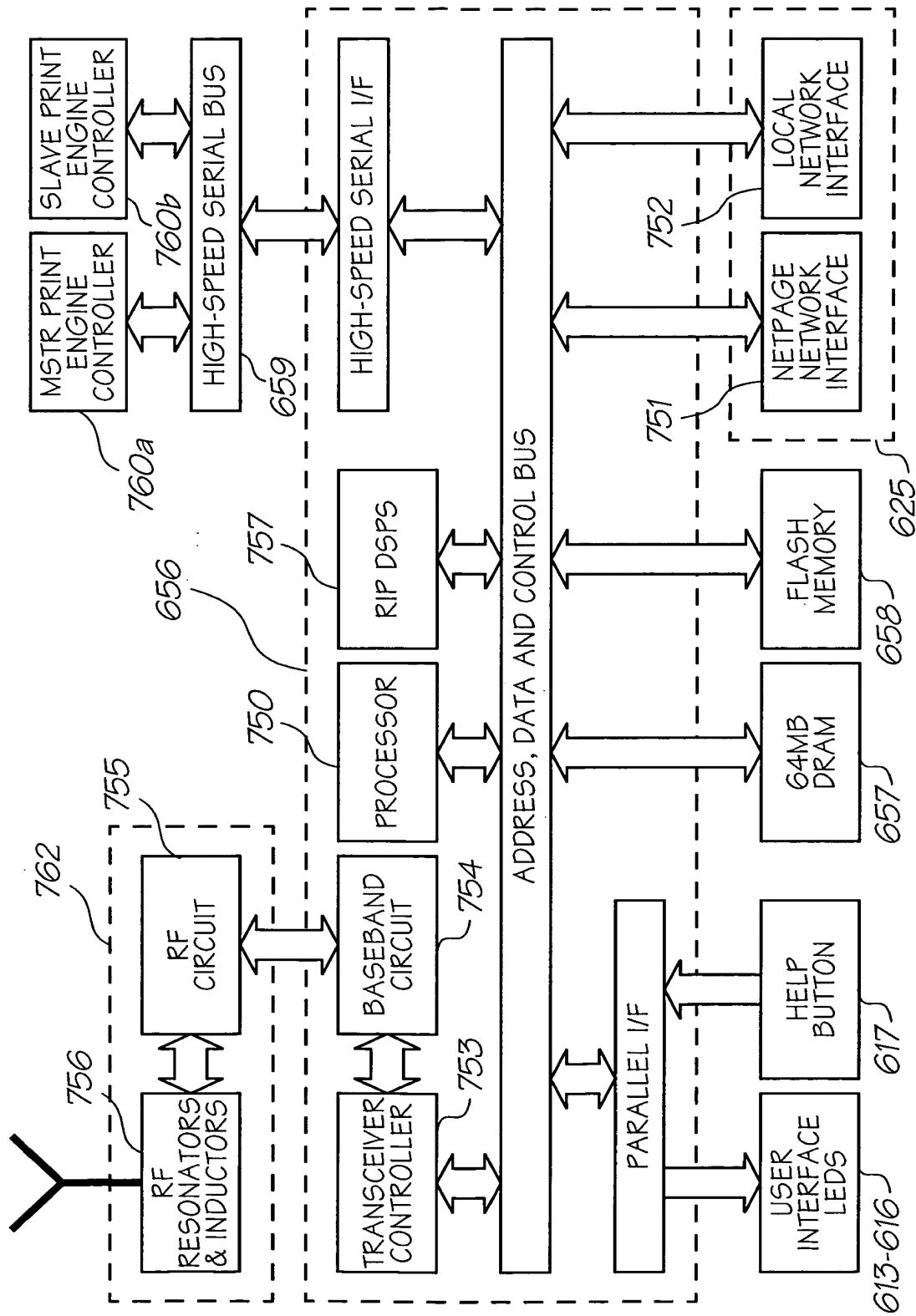


FIG. 14

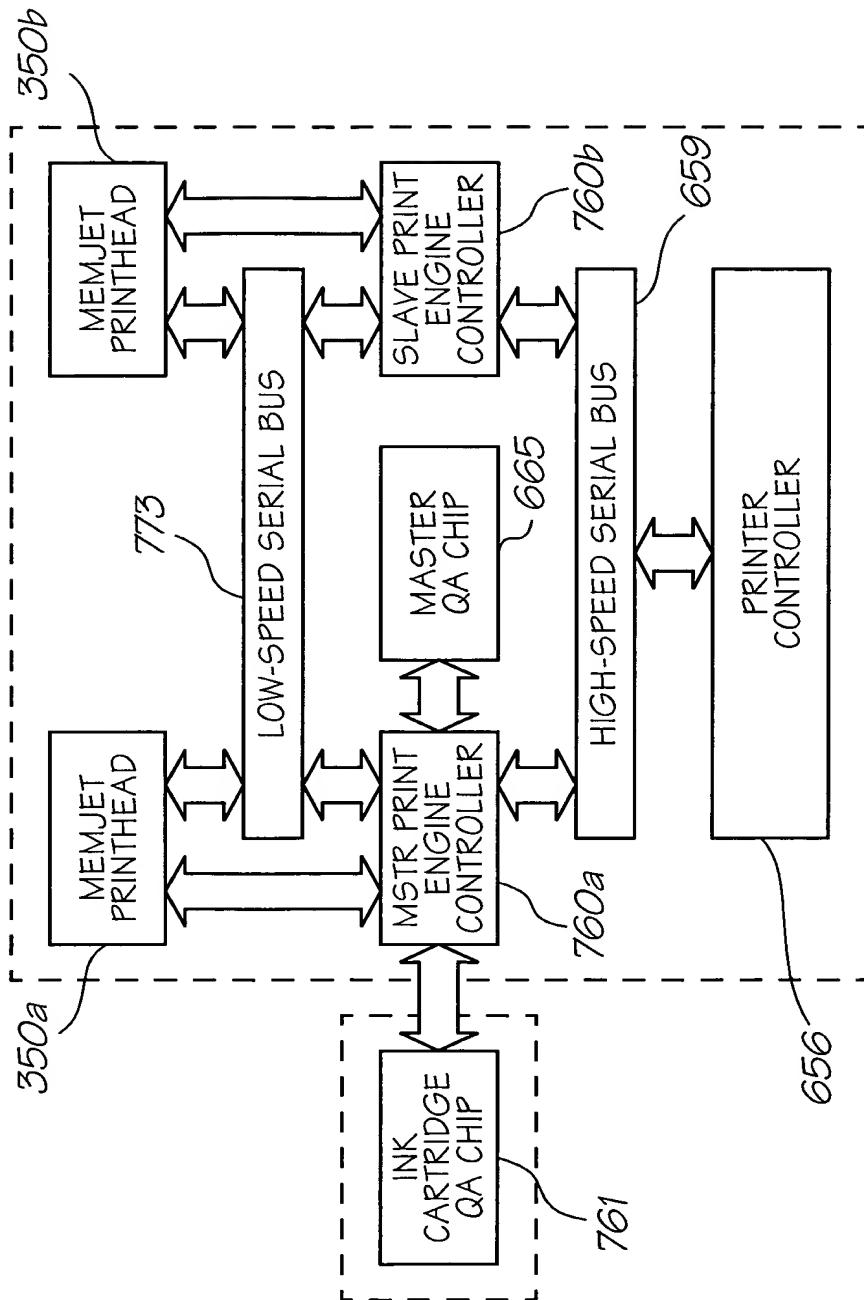


FIG. 15

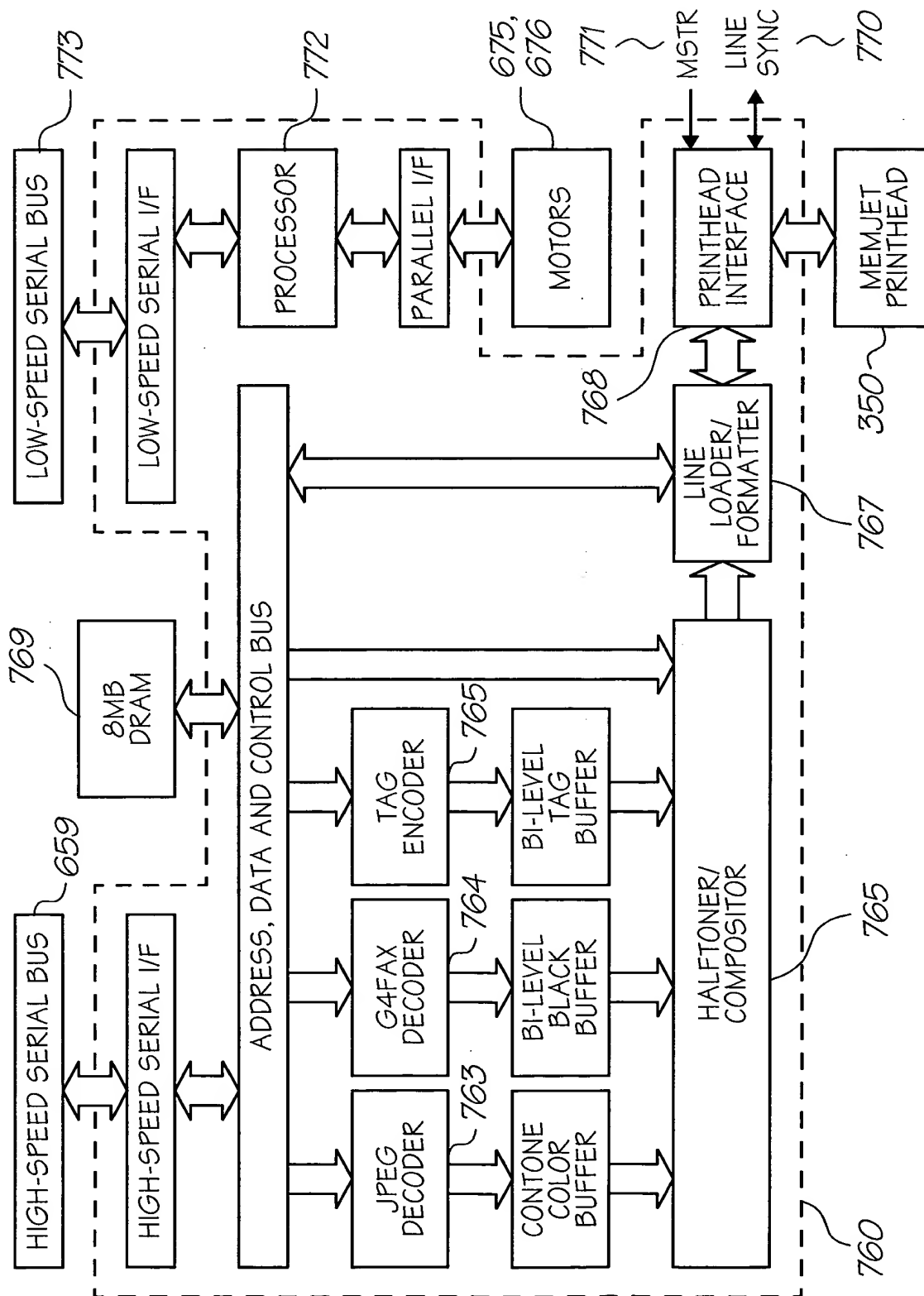


FIG. 16



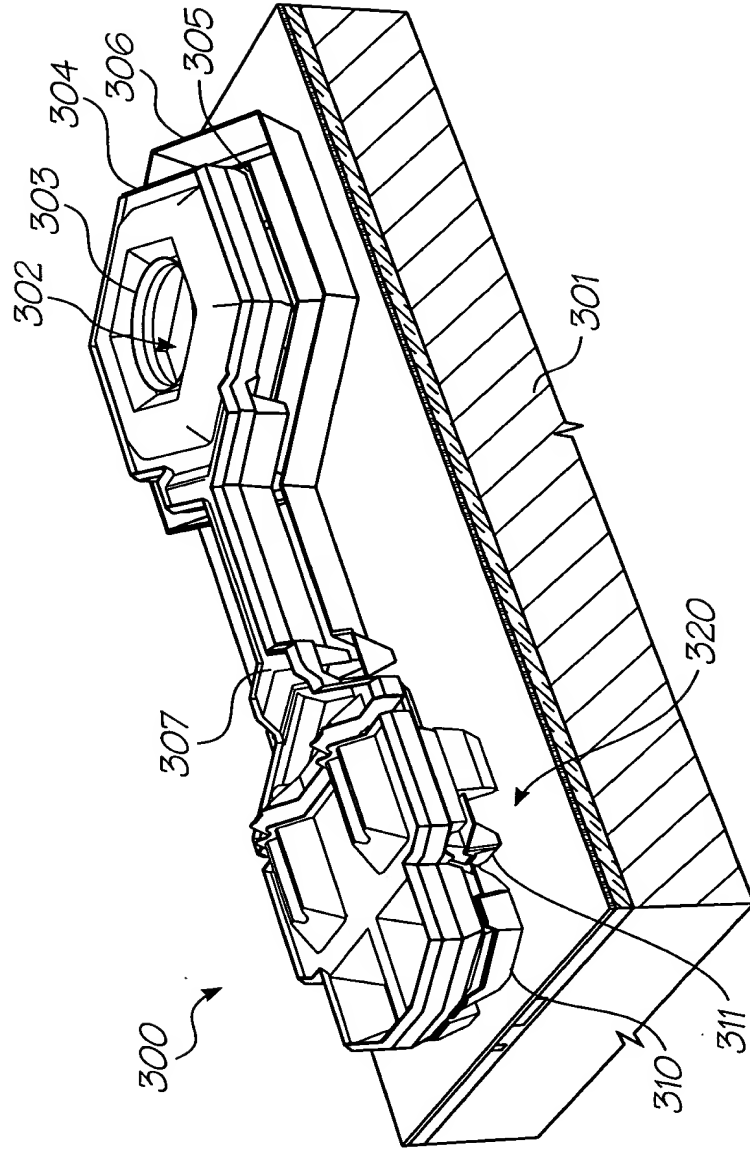


FIG. 17

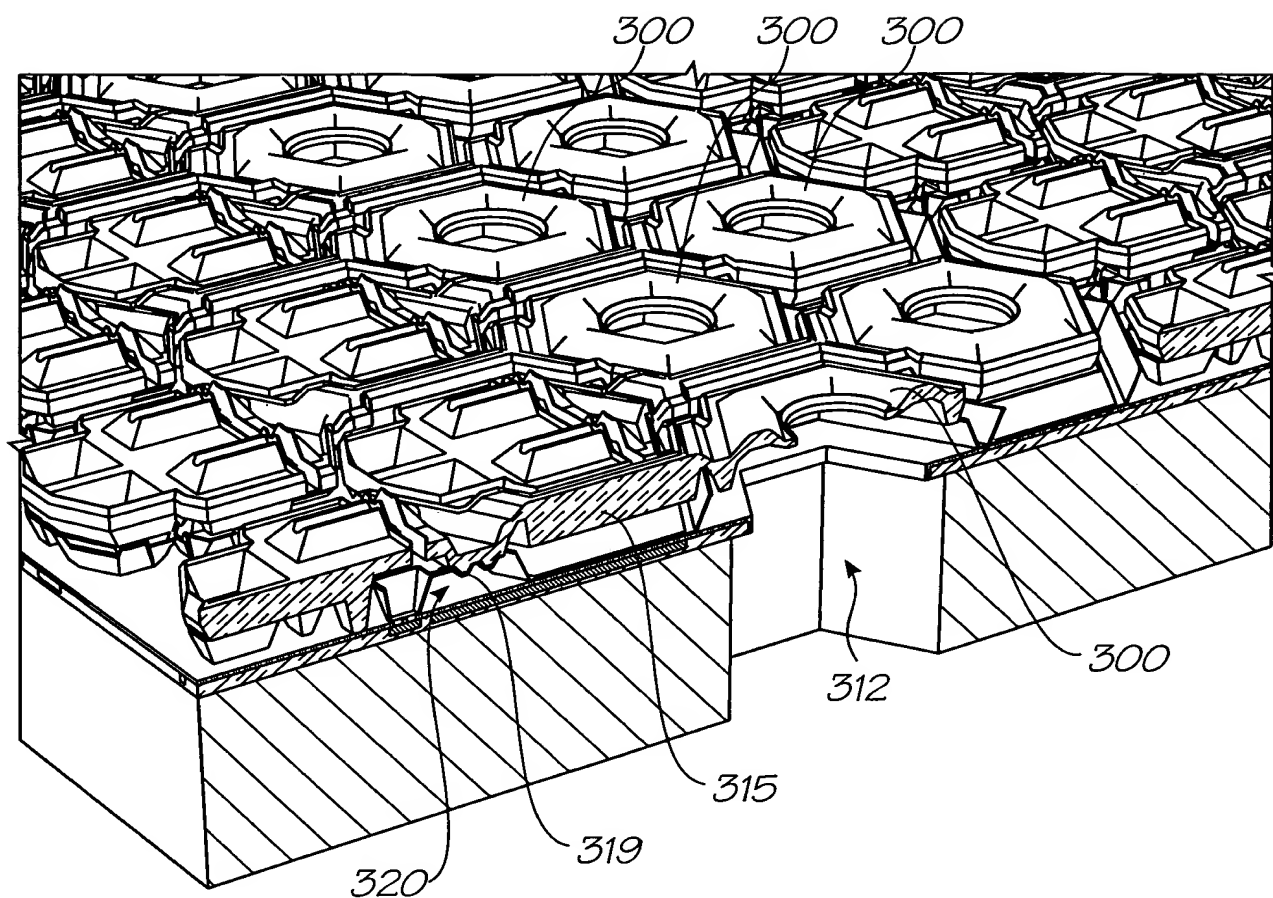


FIG. 18

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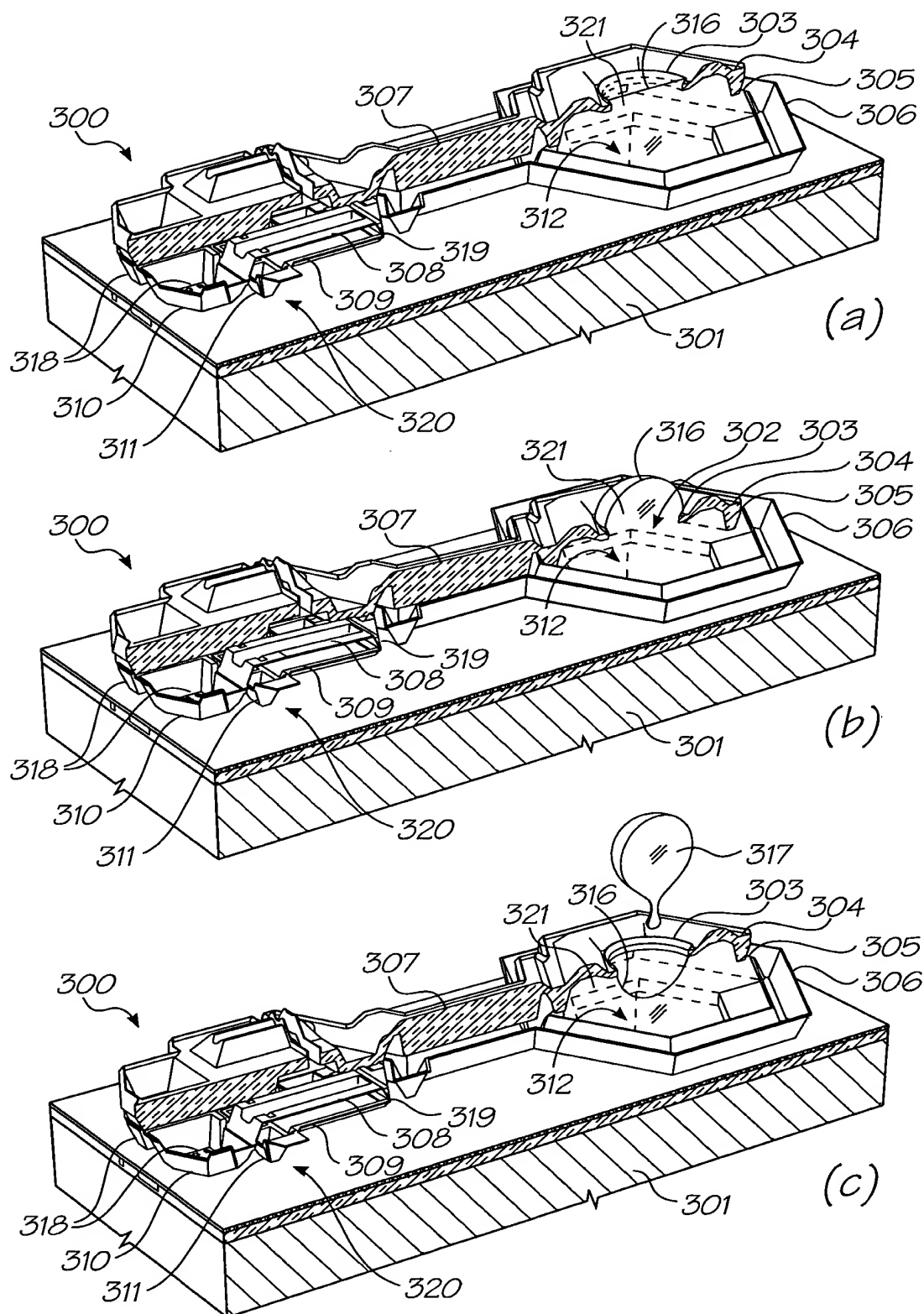


FIG. 19

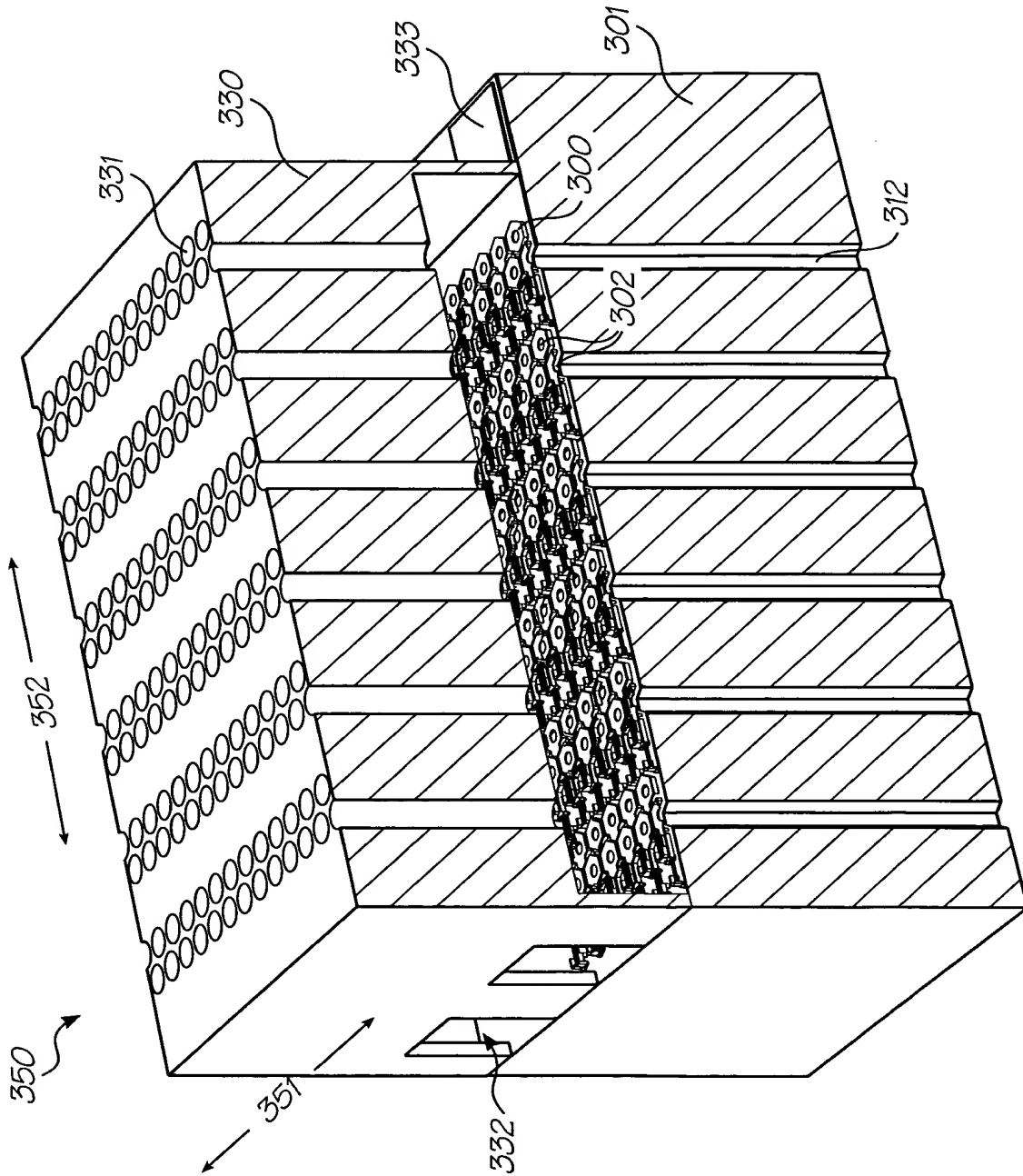


FIG. 20

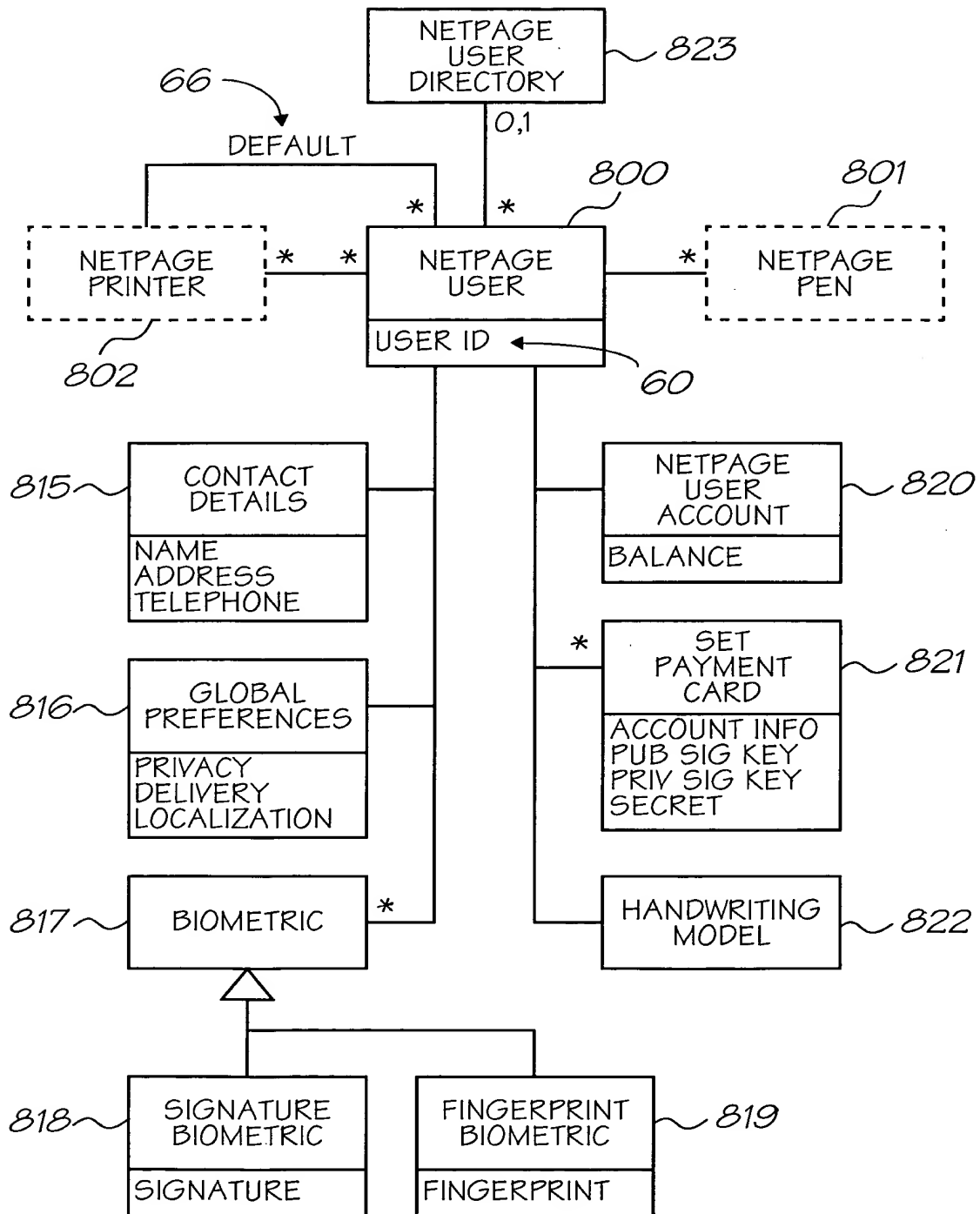


FIG. 21





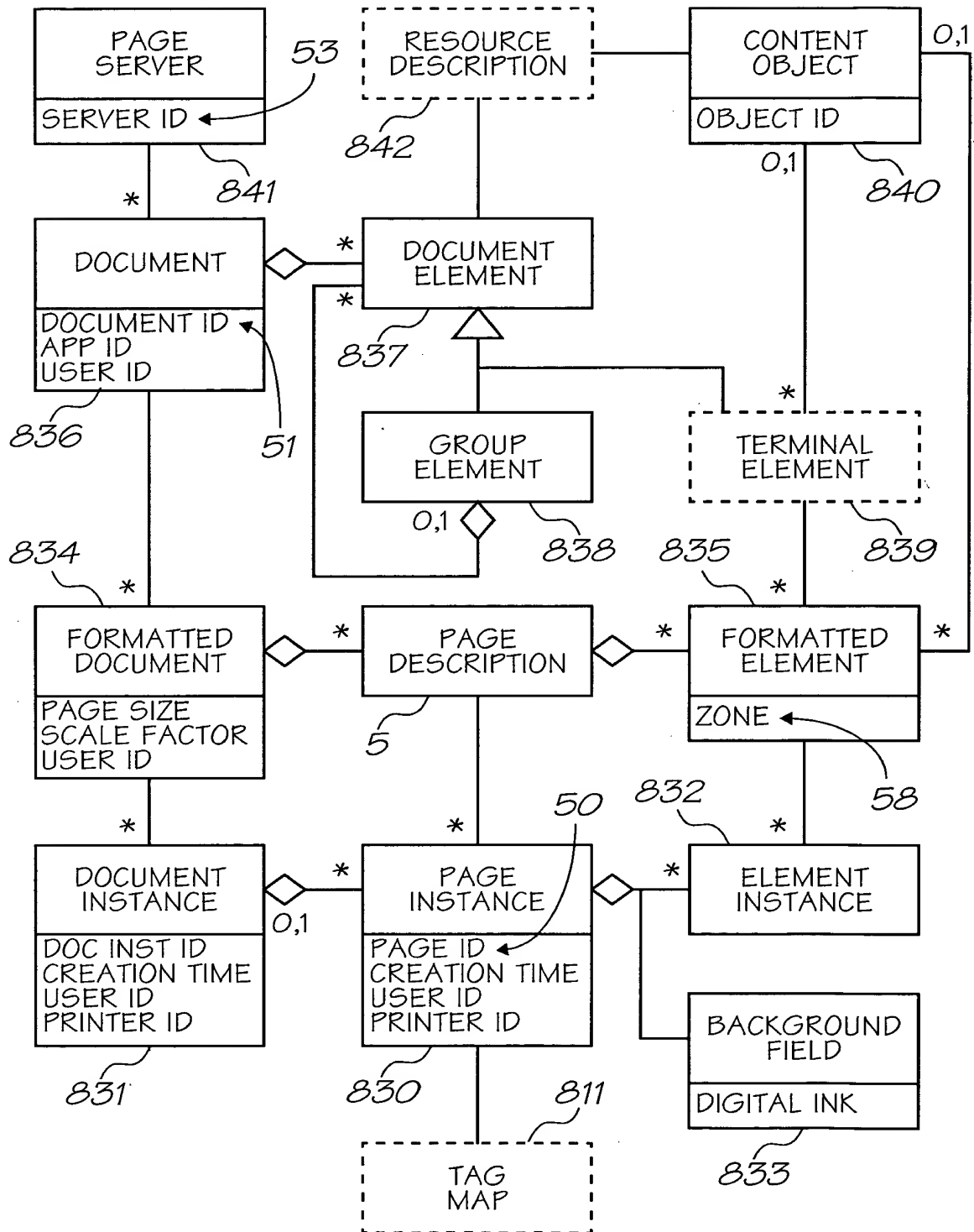


FIG. 25





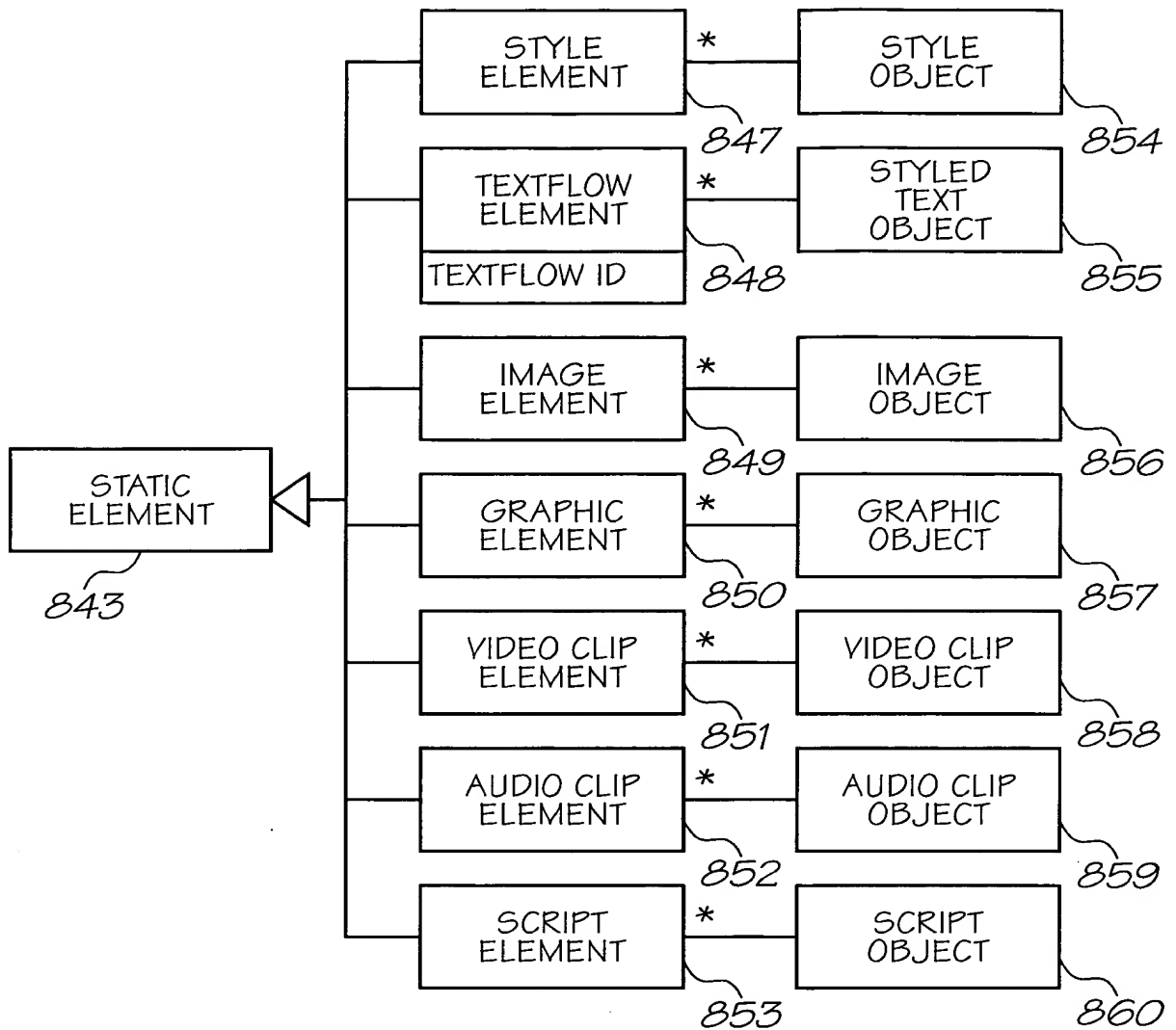


FIG. 28



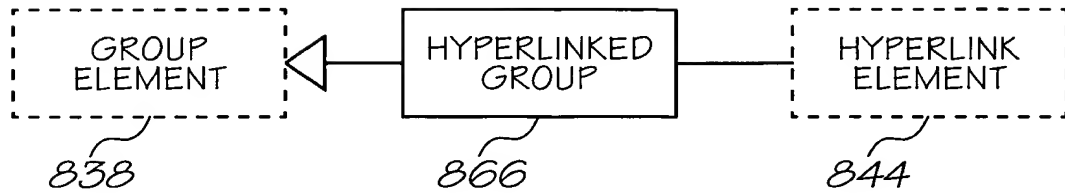


FIG. 31

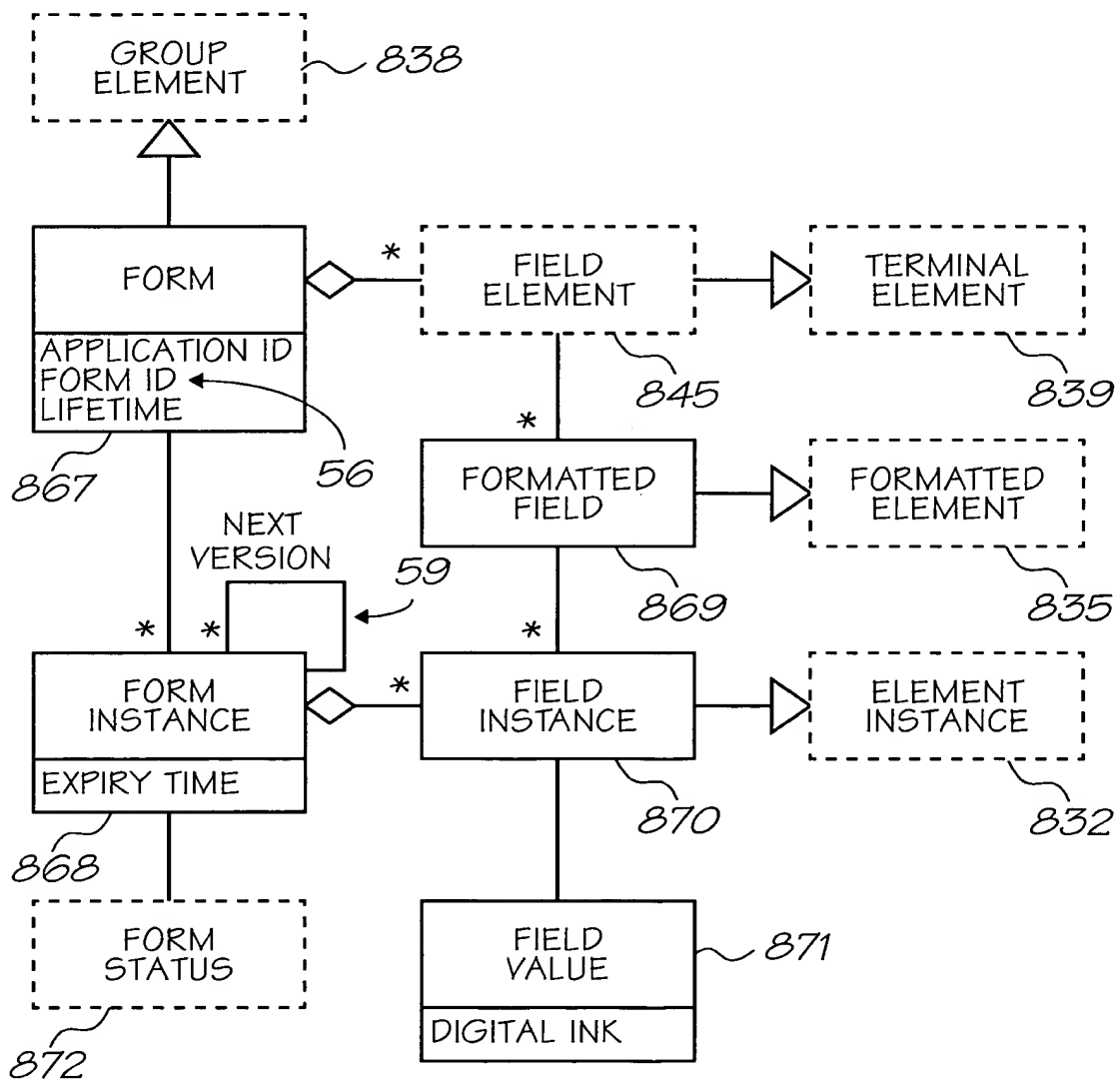


FIG. 32



FIG. 34



FIG. 34



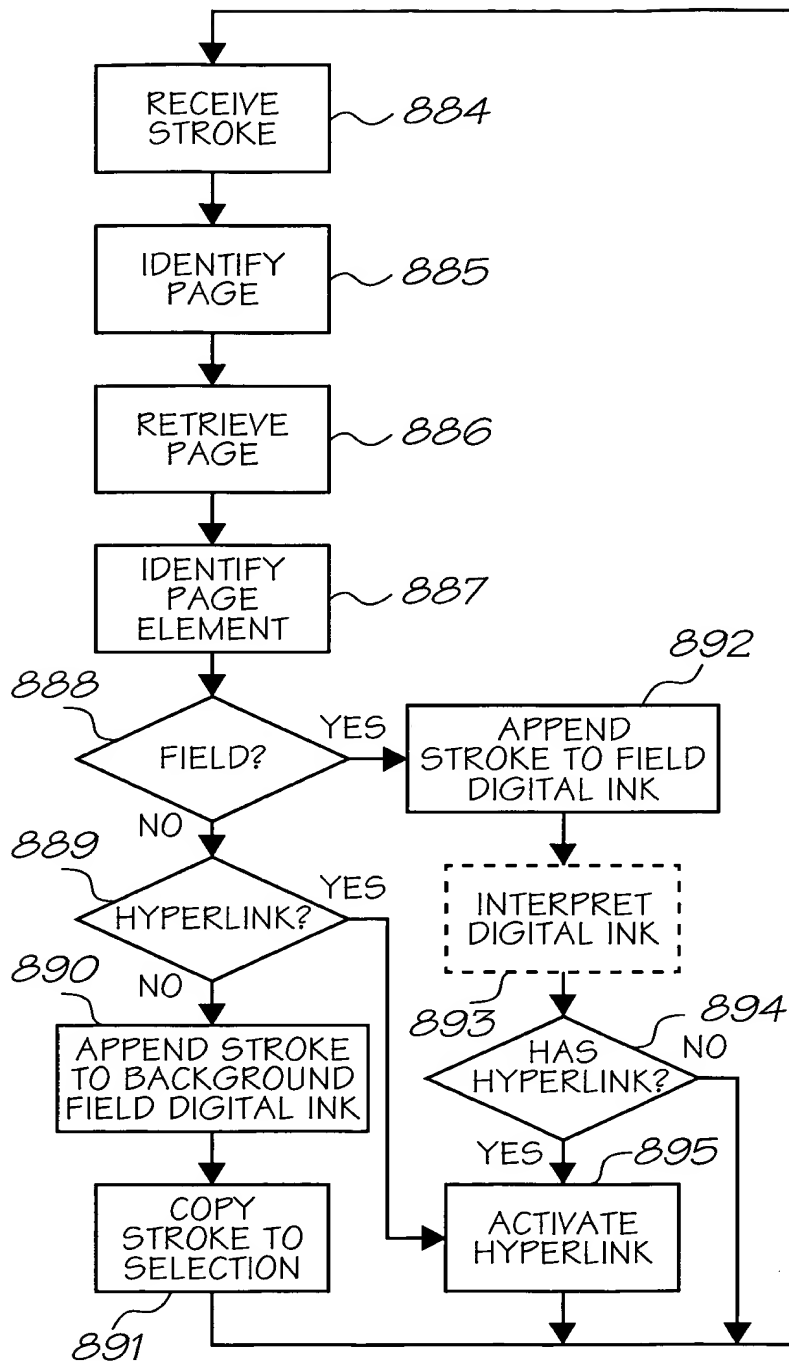
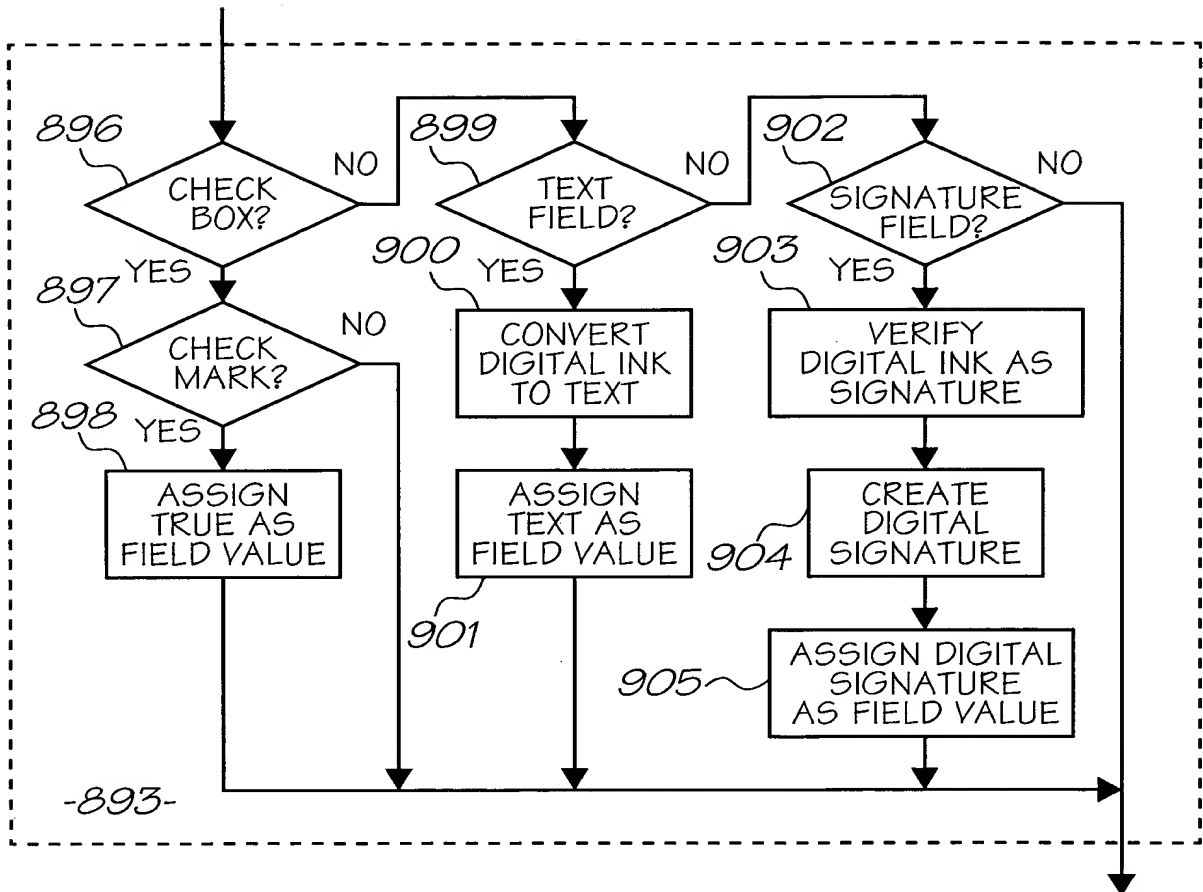


FIG. 38





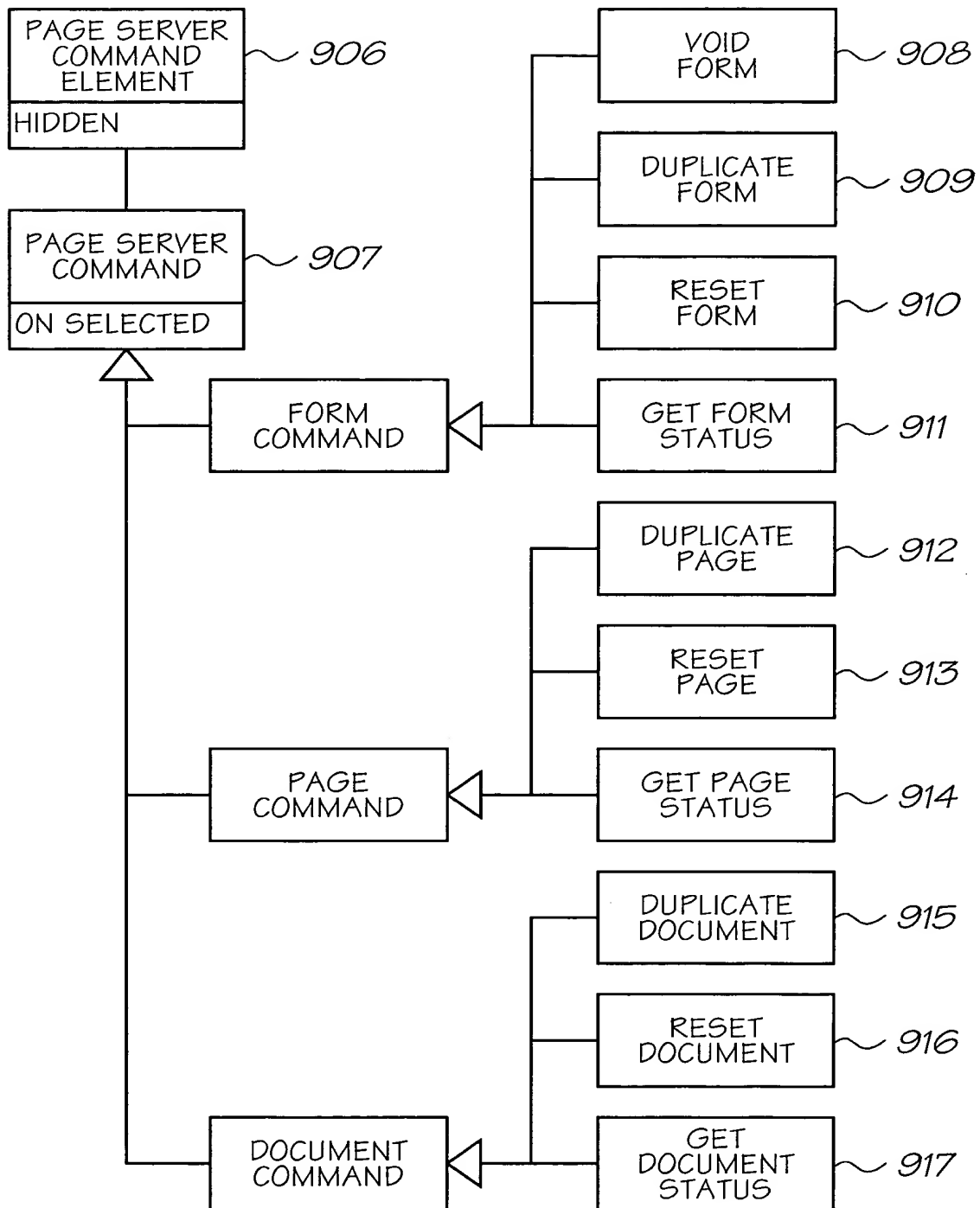


FIG. 39

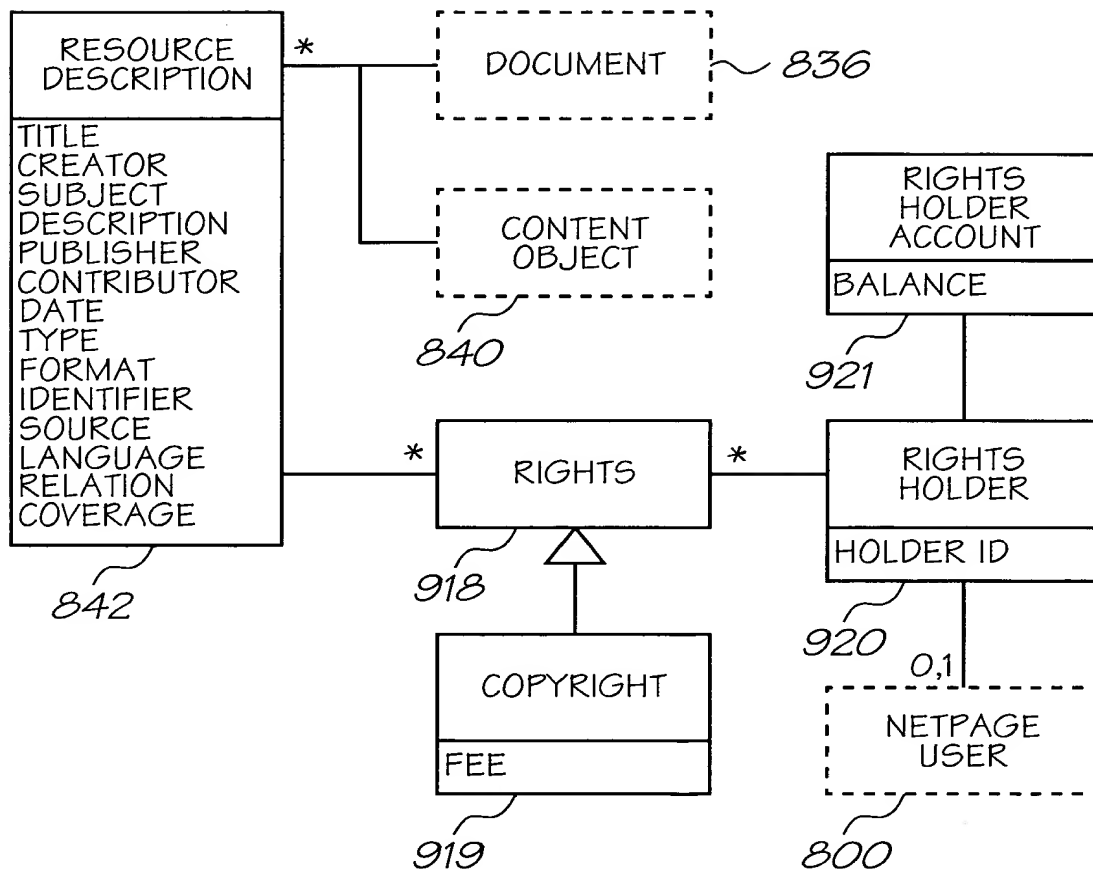


FIG. 40

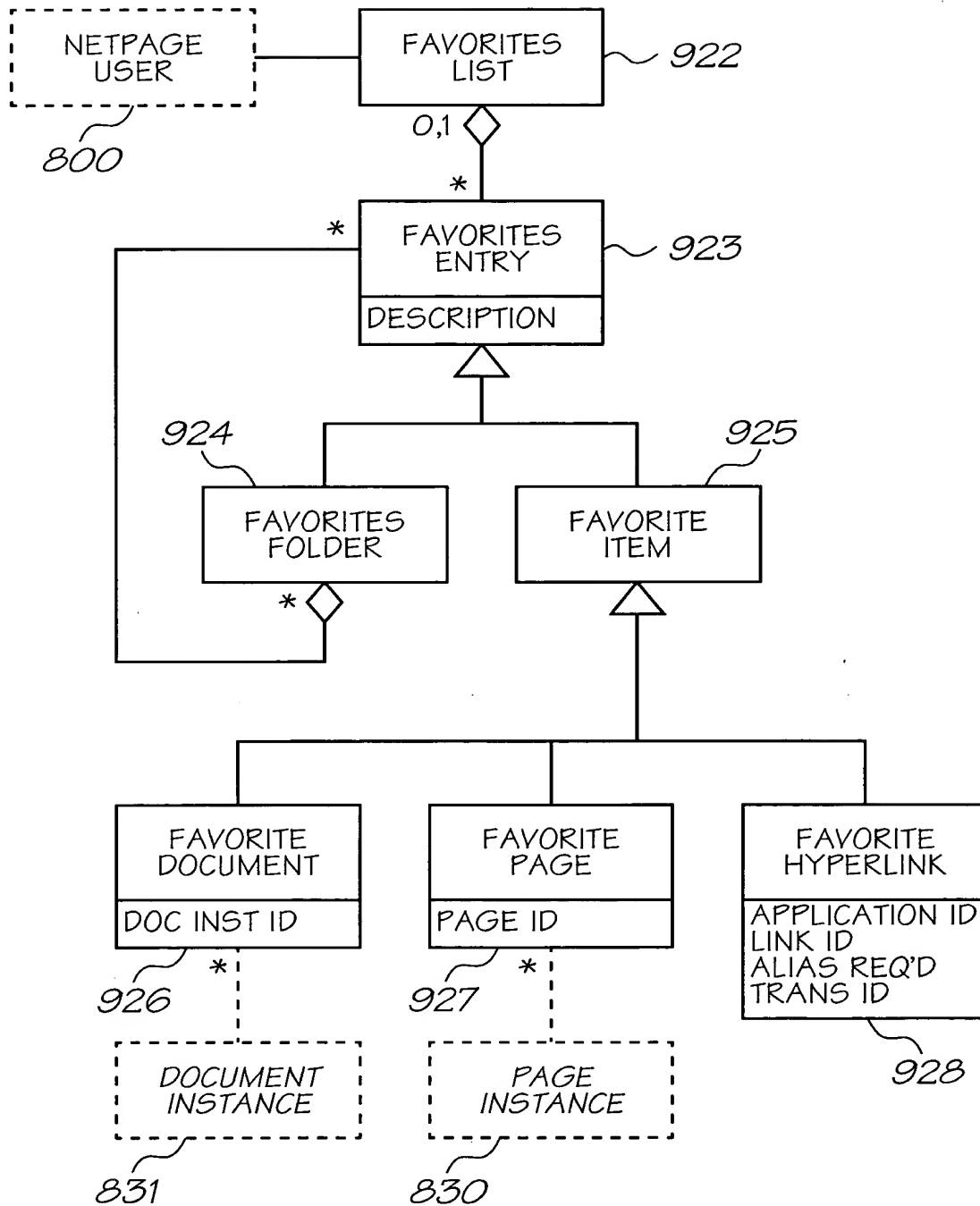


FIG. 41

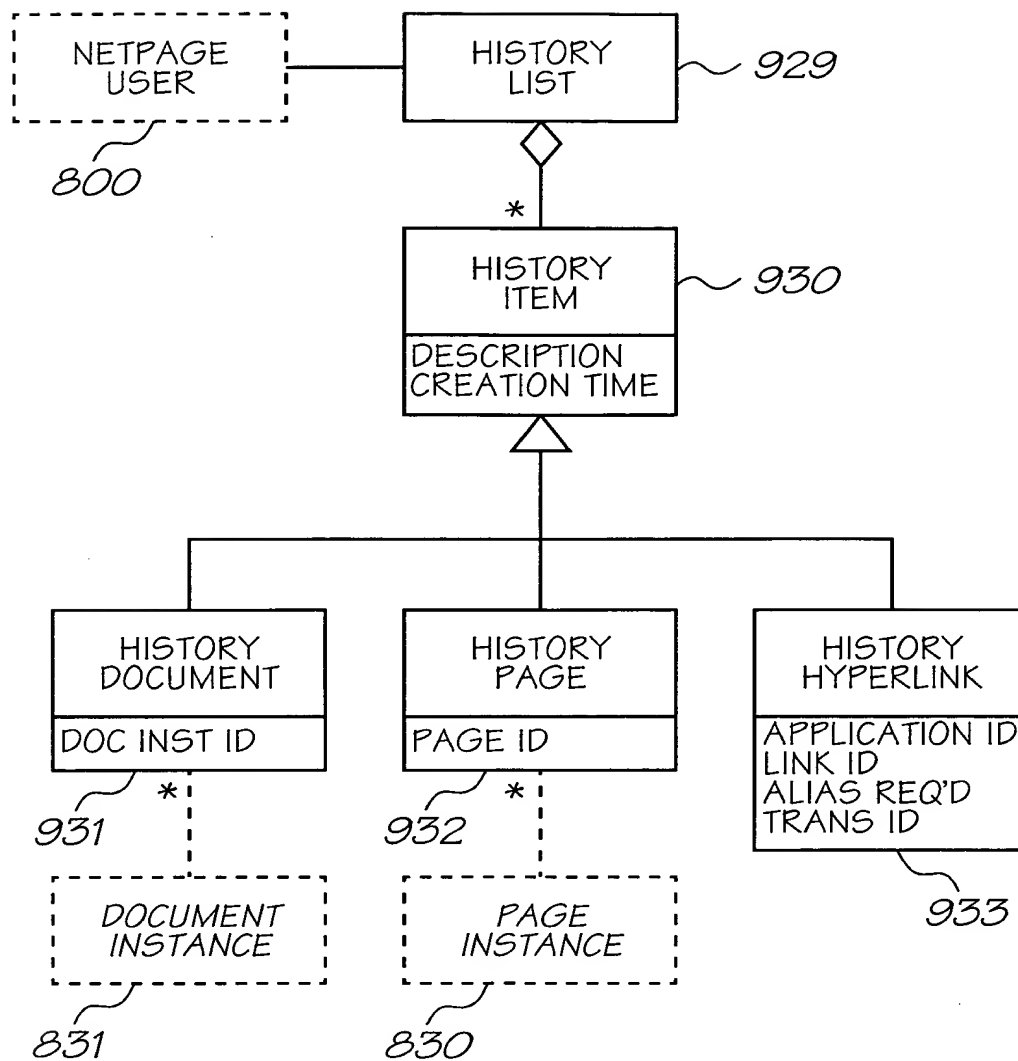


FIG. 42

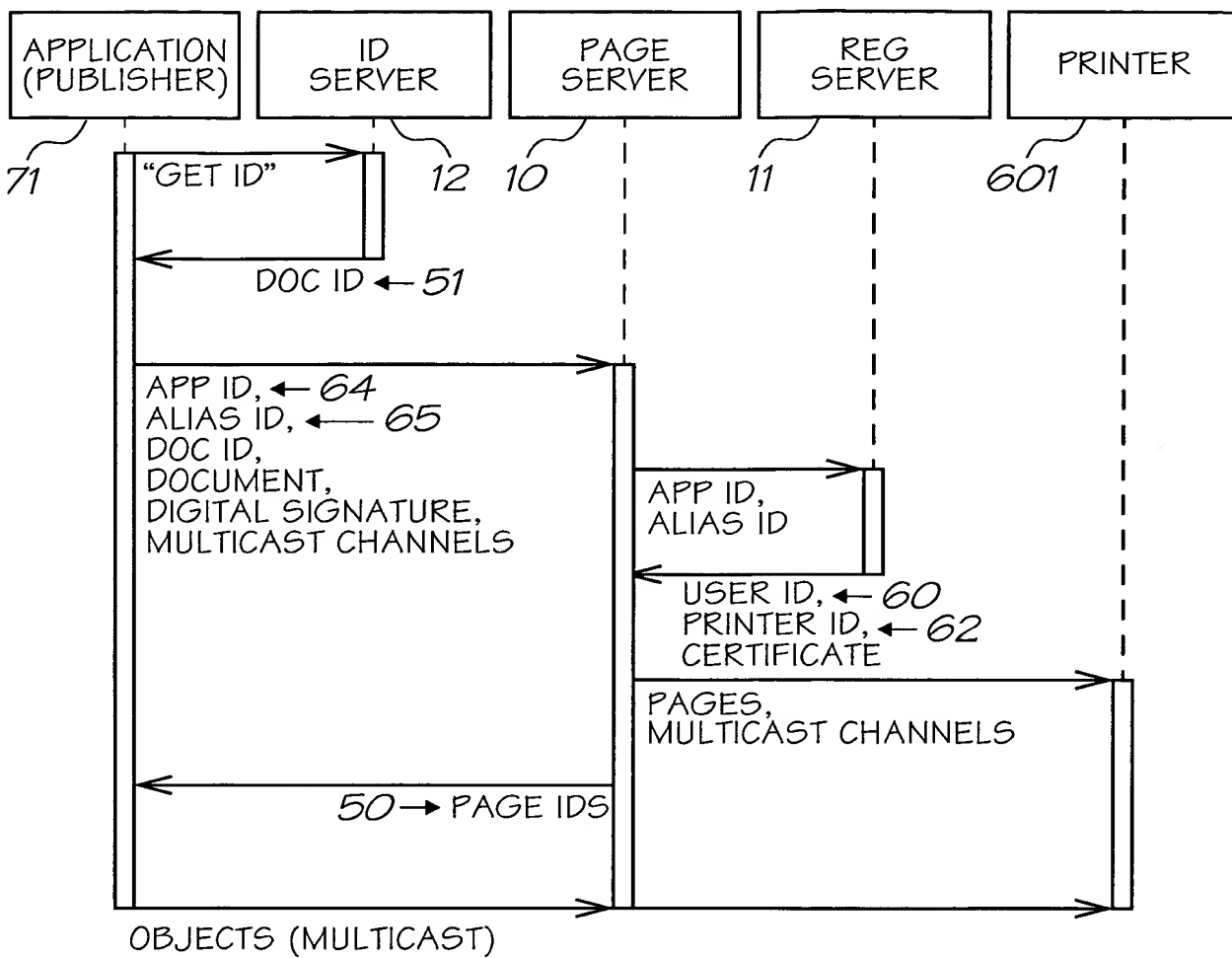


FIG. 43

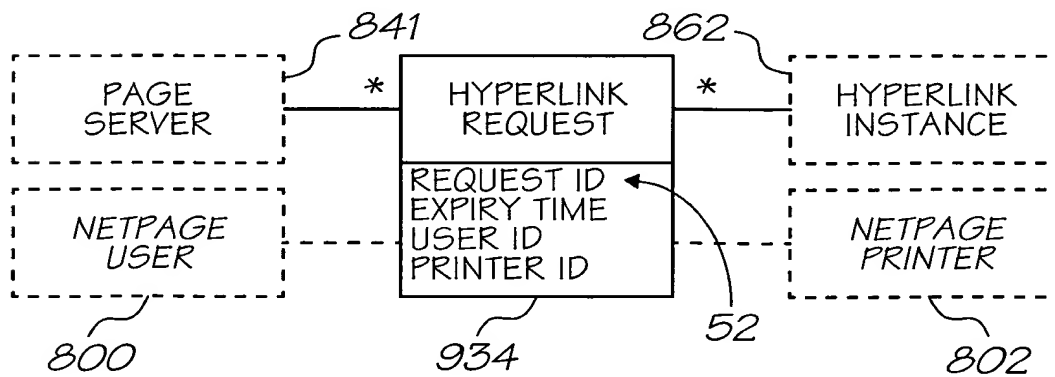


FIG. 44

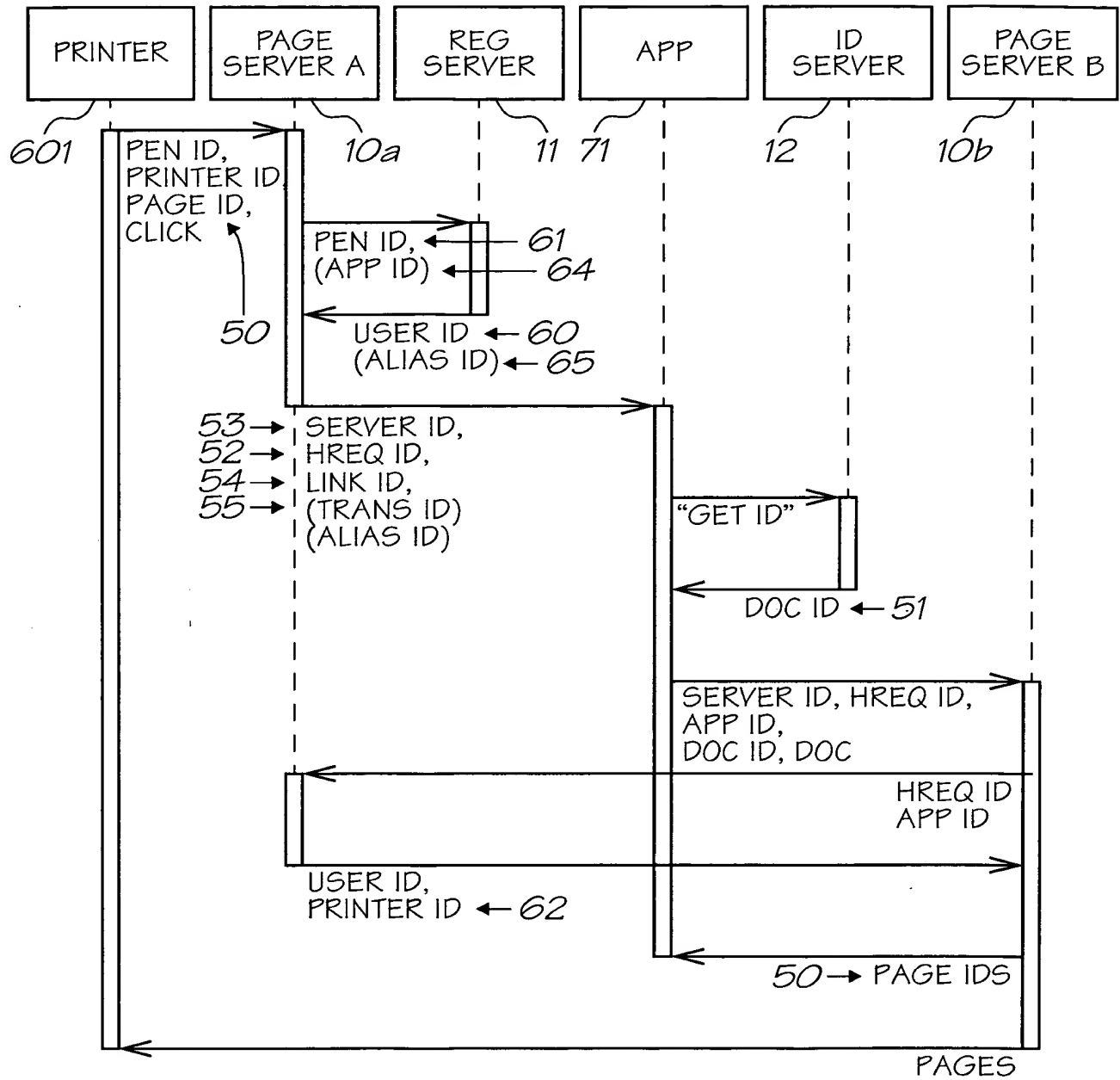


FIG. 45

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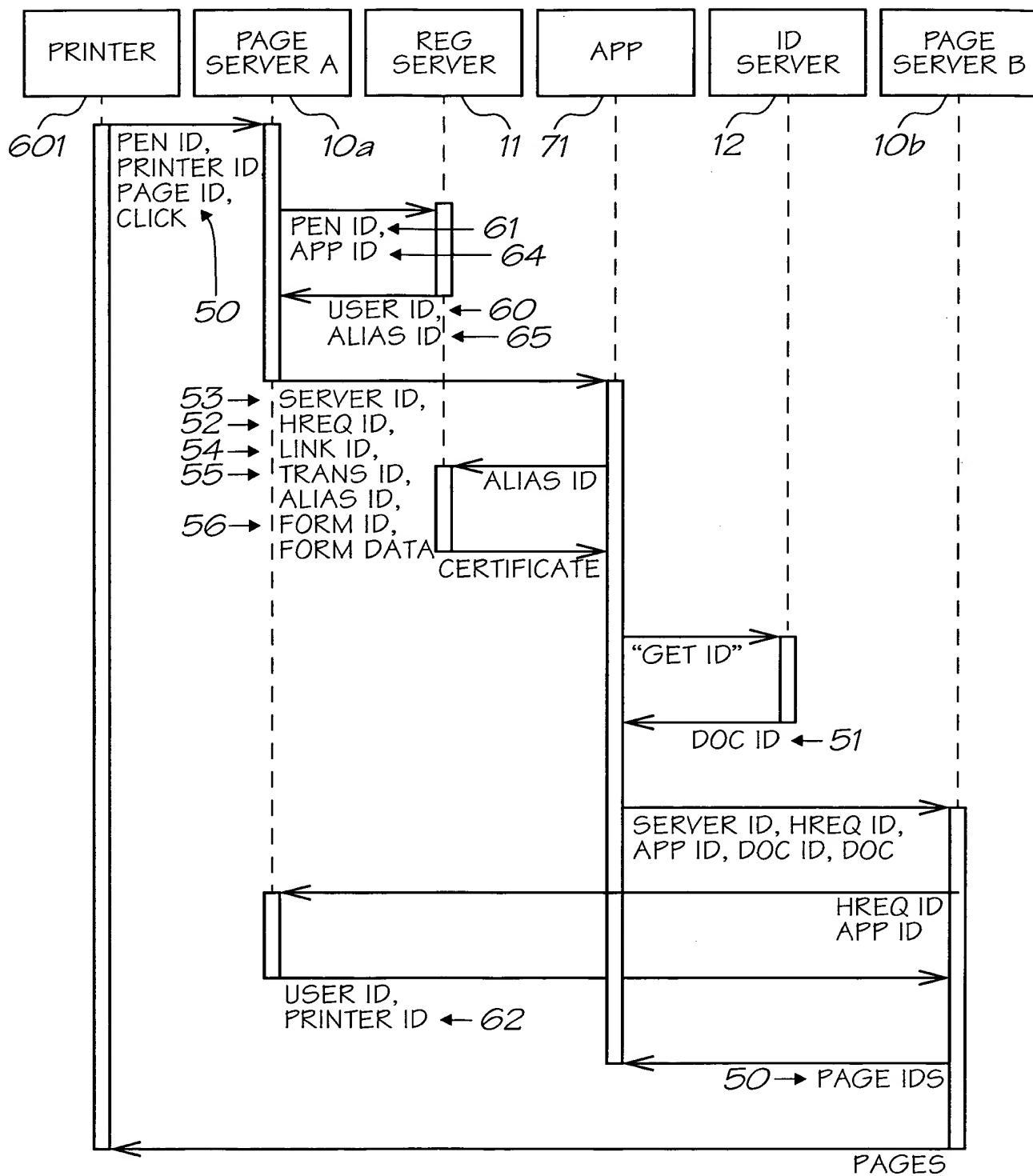


FIG. 46

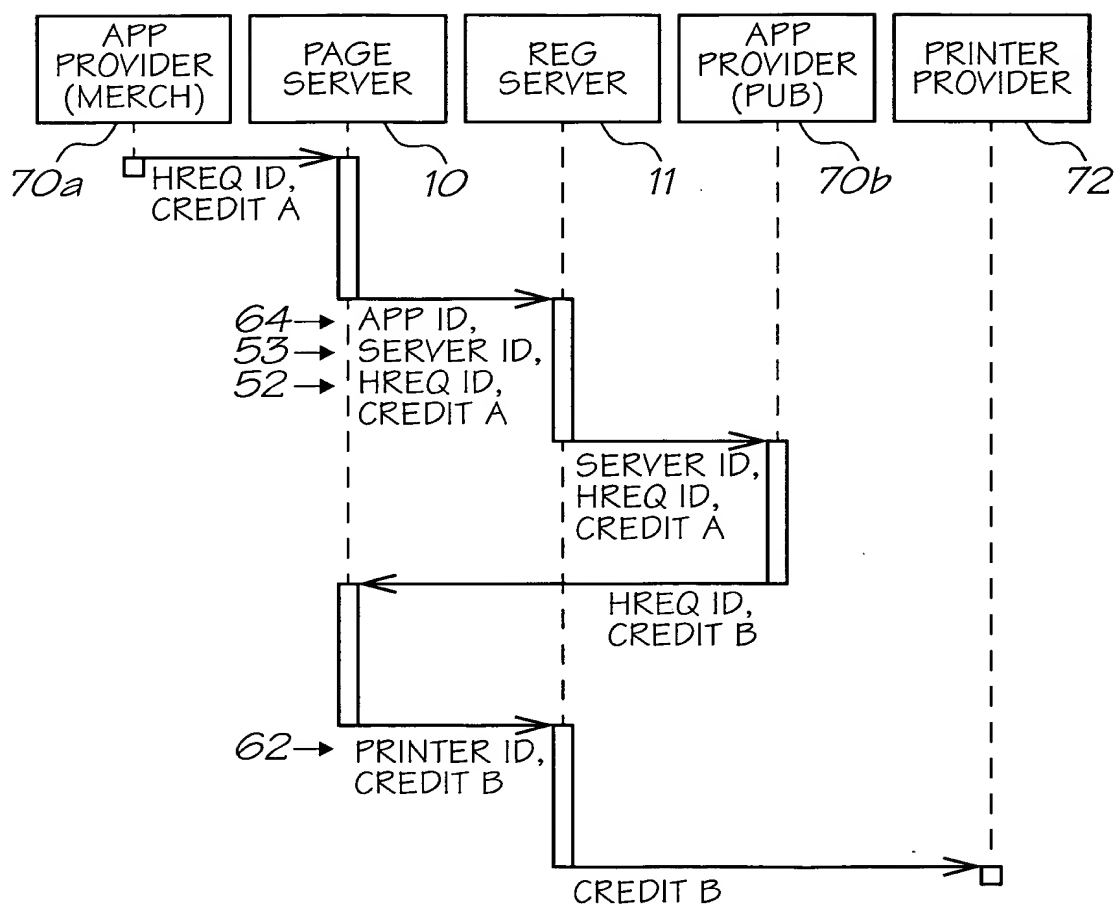


FIG. 47



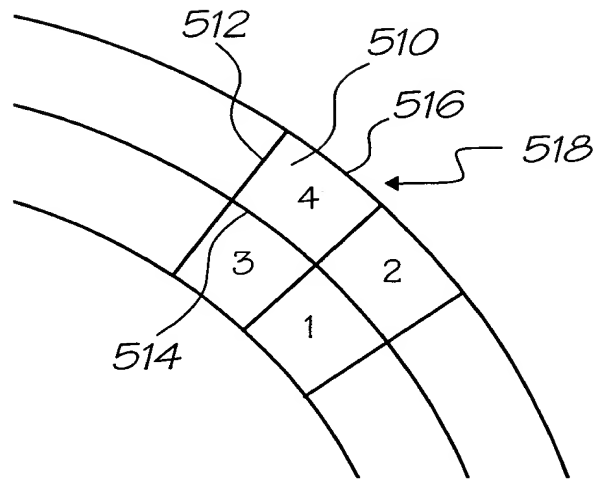


FIG. 48

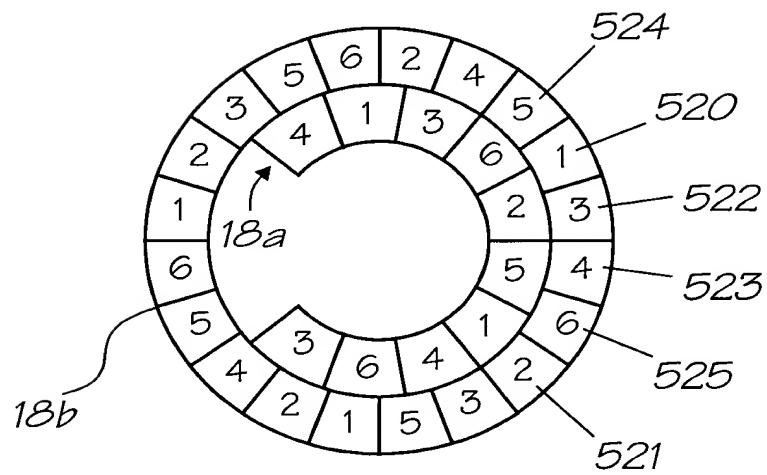


FIG. 49

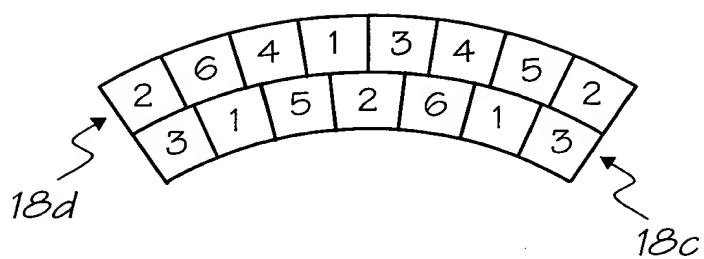


FIG. 50

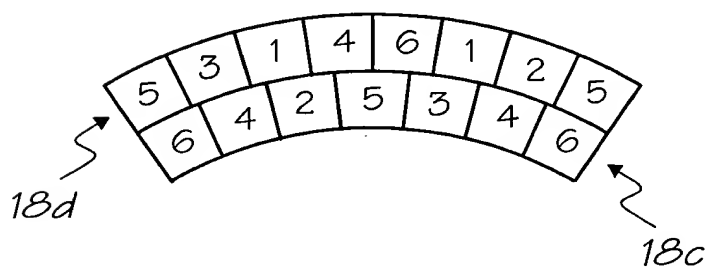


FIG. 51

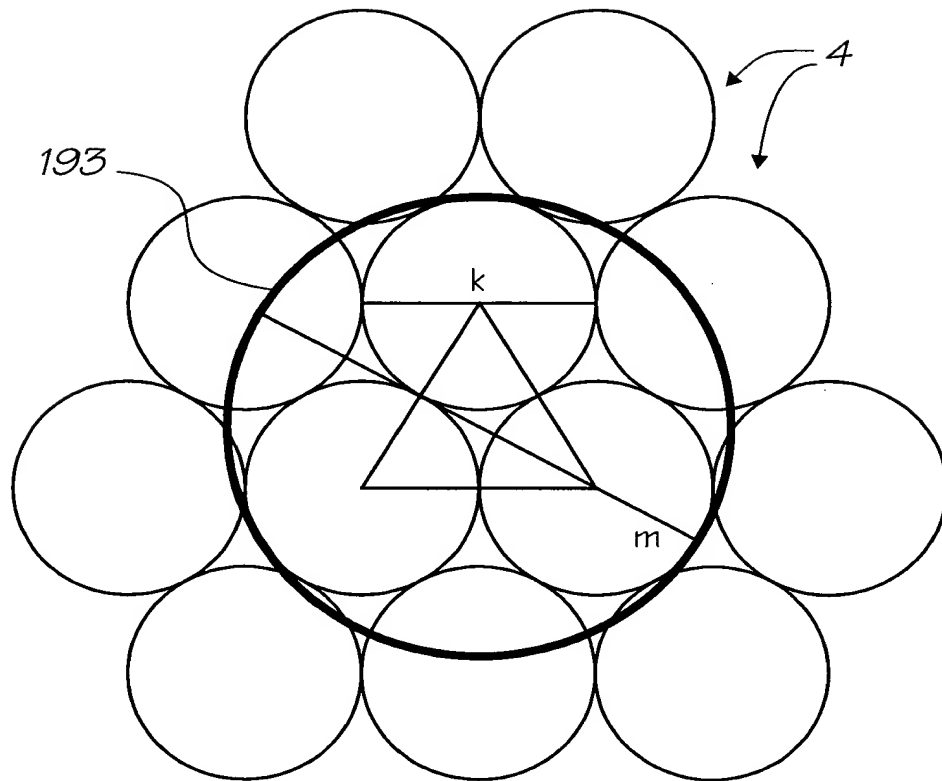


FIG. 52

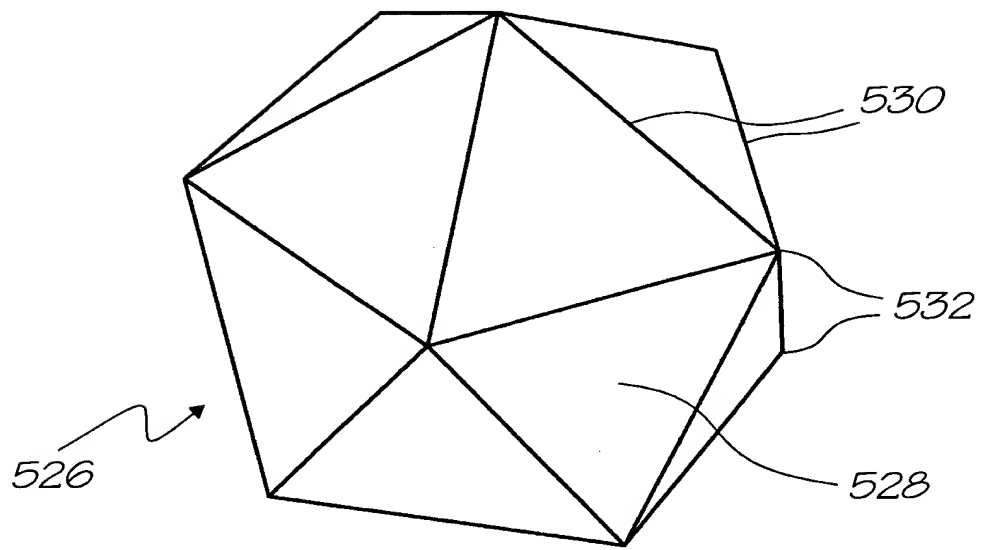


FIG. 53

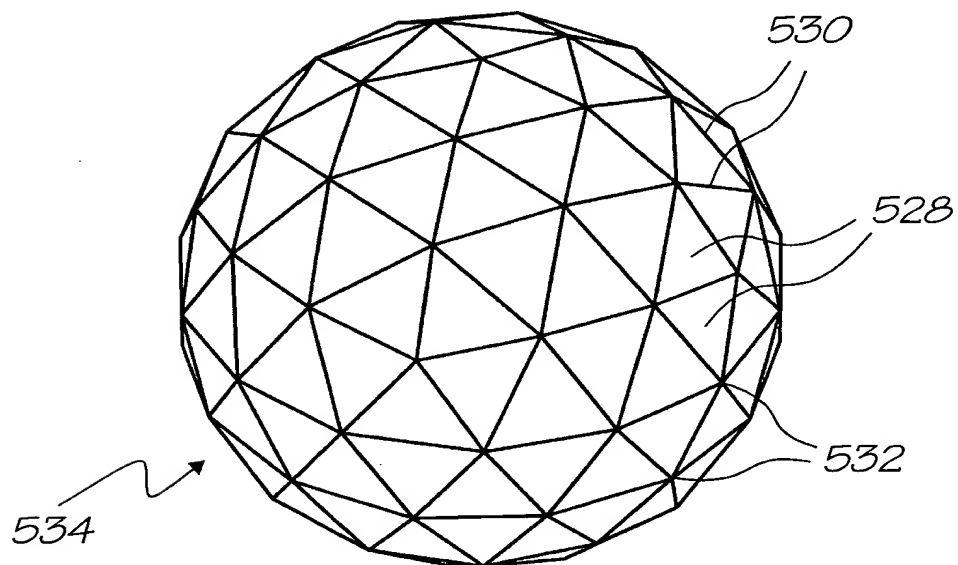


FIG. 54



FIG. 56

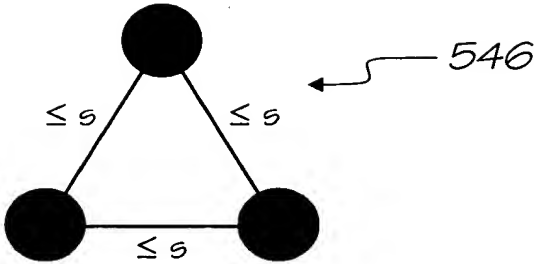


FIG. 57

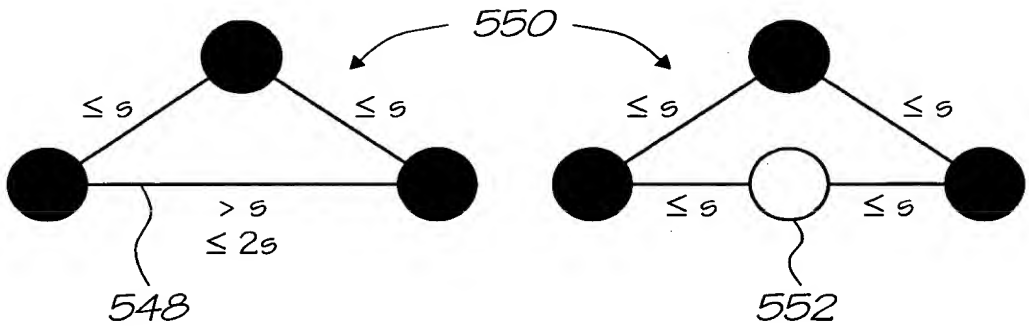
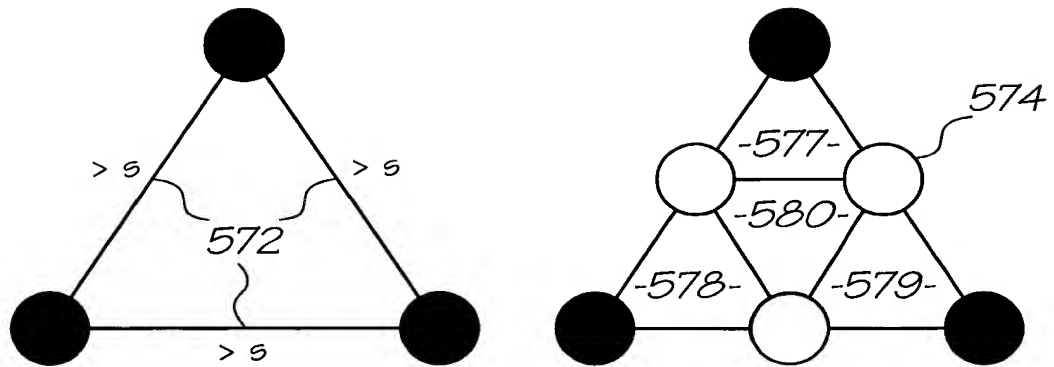


FIG. 58

09549.052300 000250" 62752560



FIG. 60



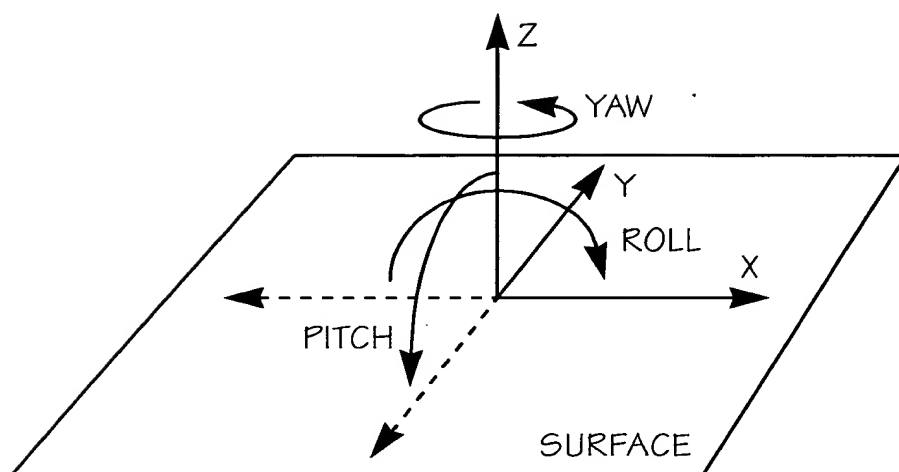


FIG. 61



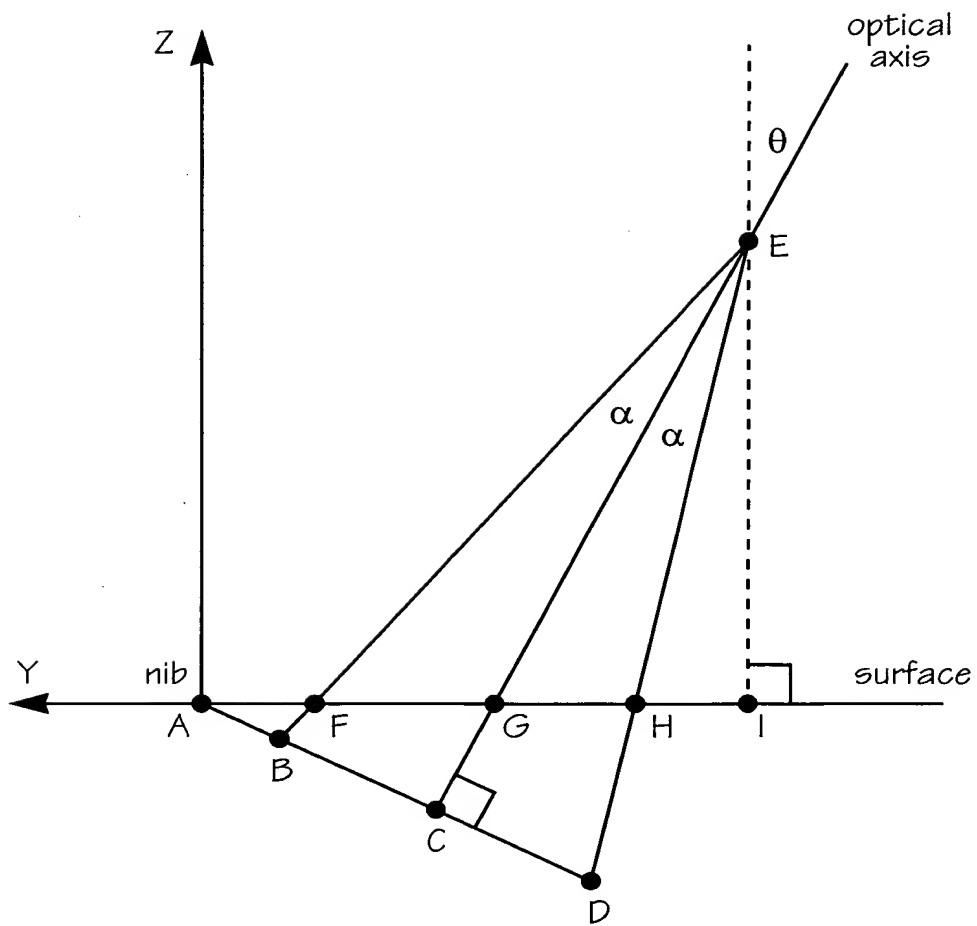


FIG. 62

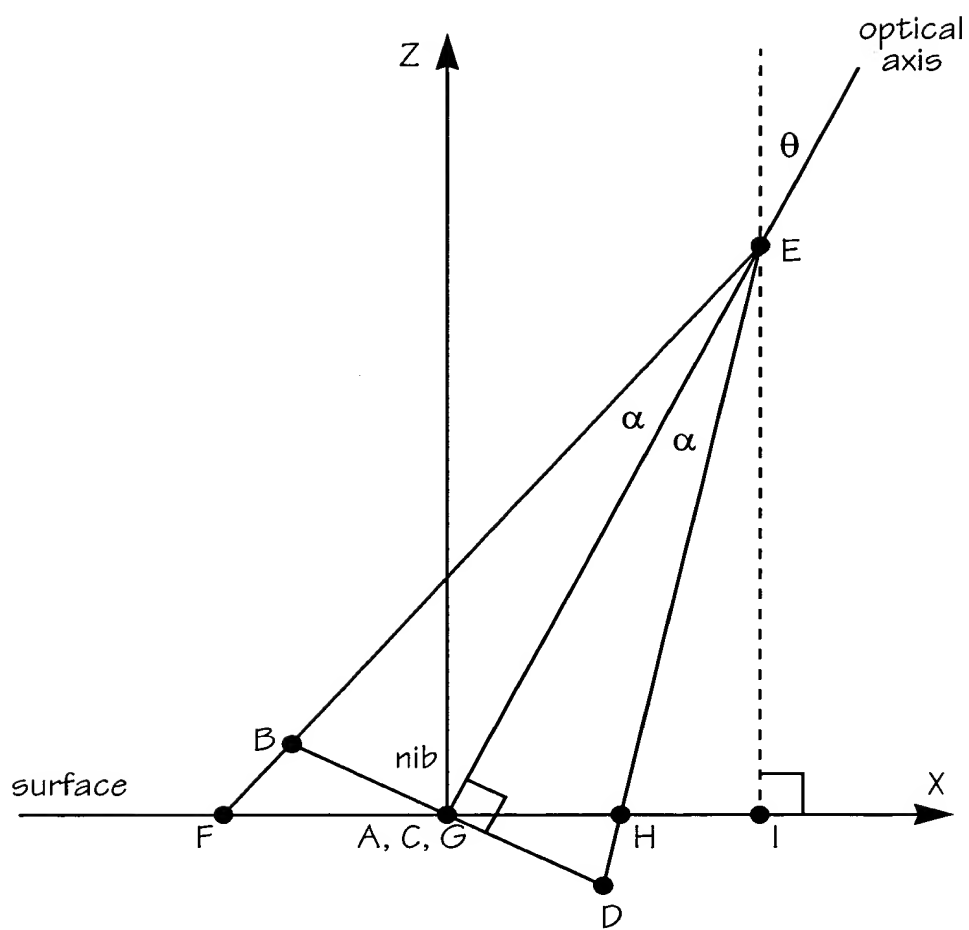


FIG. 63

FIG. 64

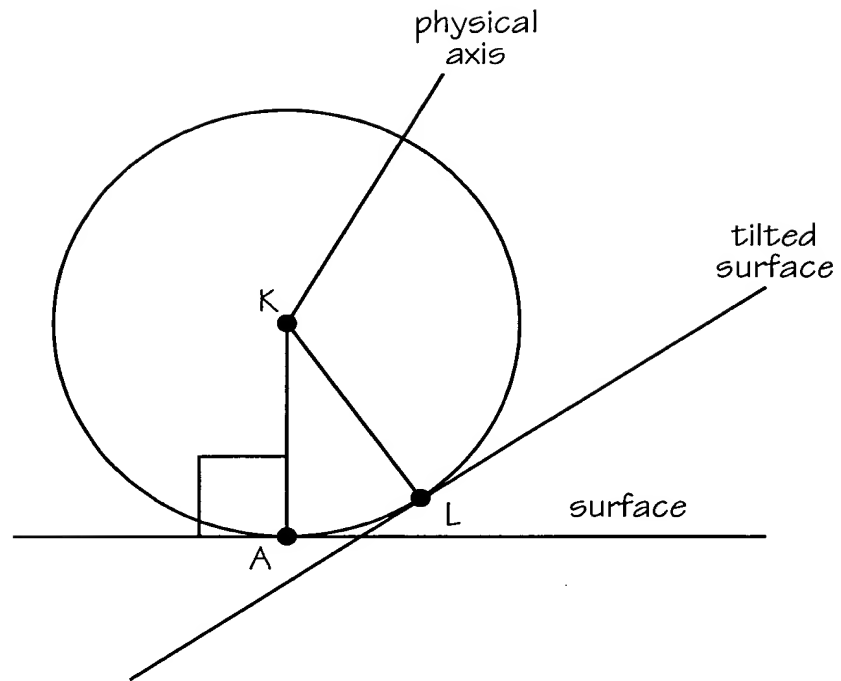


FIG. 65

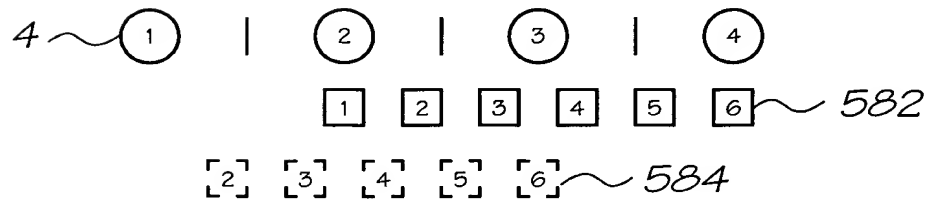


FIG. 66

FIG. 67

EQ NUMBER	EQUATION
11	$\sin \theta = \cos \phi \cos \psi$
12	$2D \tan \alpha$
13	$S = T + D \tan \alpha$
14	$d = D - S \tan \theta$
15	$d \cos \theta (\tan(\theta + \alpha) - \tan(\theta - \alpha))$
16	$d \cos \theta (\tan(\theta + \alpha) - \tan(\theta - \alpha)) \geq m$
17	$\frac{d \cos \theta}{\cos( \theta  + \alpha)}$
18	$\cos( \theta  + \alpha)$
19	$\omega = \frac{fd \cos \theta}{\cos^2( \theta  + \alpha)}$
20	$\omega_0 = \frac{fD}{\cos^2 \alpha}$

FIG. 68

FIG. 69

EQ NUMBER	EQUATION
27	$P_{sensed} = \begin{pmatrix} 0 \\ 0 \\ -d \end{pmatrix}$
28	$P_{pivot} = \begin{pmatrix} 0 \\ S \\ R - D \end{pmatrix}$
29	$\vec{V}_{pivot-sensed} = P_{pivot} - P_{sensed} = \begin{bmatrix} 0 \\ S \\ R - D + d \end{bmatrix}$
30	$\vec{N} = M \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$
31	$\vec{V}_{contact-pivot} = R \frac{\vec{N}}{ \vec{N} }$
32	$\vec{V}_{contact-sensed} = \vec{V}_{contact-pivot} - \vec{V}_{pivot-sensed}$
33	$\vec{V}_{contact-tag} = \vec{V}_{sensed-tag} + M^{-1} \vec{V}_{contact-sensed}$
34	$P_{contact} = P_{tag} + \vec{V}_{contact-tag}$

FIG. 70



EQ NUMBER	EQUATION
35	$\gamma_{pen} = -\gamma_{tag}$
36	$\phi_{pen} = -\phi_{tag} - \phi_{sensor}$
37	$\psi_{pen} = -\psi_{tag}$
38	$\lambda_S < \frac{\lambda_T}{2}$
39	$P_{i+1} - P_i = \lambda_S$
40	$ \lambda_T - (P_{i+1} - P_i)  = \lambda_S$
41	$\lambda_S = \frac{\lambda_T}{2}$

FIG. 71

EQ NUM	EQUATION
42	$M_1 = T_{xy} = \begin{bmatrix} 1 & 0 & 0 & A \\ 0 & 1 & 0 & B \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$
43	$R_z = \begin{bmatrix} C & -D & 0 & 0 \\ D & C & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$
44	$M_2 = R_z M_1 = \begin{bmatrix} C & -D & 0 & AC - BD \\ D & C & 0 & AD + BC \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$

FIG. 72

EQ NUM	EQUATION	
45	$R_x = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & E & -F & 0 \\ 0 & F & E & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$	
46	$M_3 = R_x M_2 = \begin{bmatrix} C & -D & 0 & AC - BD \\ DE & CE & -F & ADE + BCE \\ DF & CF & E & ADF + BCF \\ 0 & 0 & 0 & 1 \end{bmatrix}$	
47	$R_y = \begin{bmatrix} G & 0 & H & 0 \\ 0 & 1 & 0 & 0 \\ -H & 0 & G & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$	

FIG. 73

EQ NUM	EQUATION
48	$M_4 = R_y M_3 = \begin{bmatrix} CG + DFH & CFH - DG & EH & GK + HL \\ DE & CE & -F & ADE + BCE \\ DFG - CH & DH + CFG & EG & GL - HK \\ 0 & 0 & 0 & 1 \end{bmatrix}$
49	$K = AC - BD$
50	$L = ADF + BCF$
51	$T_z = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & I \\ 0 & 0 & 0 & 1 \end{bmatrix}$

FIG. 74

EQ NUM	EQUATION		
52	$M_5 = T_z M_4 = \begin{bmatrix} CG + DFH & CFH - DG & EH & GK + HL \\ DE & CE & -F & ADE + BCE \\ DFG - CH & DH + CFG & EG & GL - HK + I \\ 0 & 0 & 0 & 1 \end{bmatrix}$		
53	$M_p = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & J & 1 \end{bmatrix}$		
54	$M_6 = M_p M_5 = \begin{bmatrix} CG + DFH & CFH - DG & EH & GK + HL \\ DE & CE & -F & ADE + BCE \\ 0 & 0 & 0 & 0 \\ J(DFG - CH) & J(DH + CFG) & EGJ & J(GL - HK + I) + 1 \end{bmatrix}$		

FIG. 75

EQ NUM	EQUATION
55	$M_s = \begin{bmatrix} S & 0 & 0 & 0 \\ 0 & S & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$
56	$M_7 = M_s M_6 = \begin{bmatrix} S(CG + DFH) & S(CFH - DG) & SEH & S(GK + HL) \\ SDE & SCE & -SF & S(ADE + BCE) \\ 0 & 0 & 0 & 0 \\ J(DFG - CH) & J(DH + CFG) & EGJ & J(GL - HK + I) + 1 \end{bmatrix}$
57	$P_1 = M_7 \begin{bmatrix} x \\ y \\ 0 \\ 1 \end{bmatrix}$

FIG. 76

EQ NUM	EQUATION
58	$P_1 = \frac{S(CG + DFH)x + S(CFH - DG)y + S(GK + HL)}{SDEx + SCEy + S(ADE + BCE)} \left[ \frac{0}{J(DFG - CH)x + J(DH + CFG)y + J(GL - HK + I) + 1} \right]$
59	$P_1 = \frac{S(CG + DFH)x + S(CFH - DG)y + S(ACG - BDG + ADFH + BCFH)}{SDEx + SCEy + S(ADE + BCE)} \left[ \frac{0}{J(DFG - CH)x + J(DH + CFG)y + J(BDH - ACH + ADFG + BCFG + I) + 1} \right]$

FIG. 77

FIG. 78



FIG. 79

FIG. 80

FIG. 81

FIG. 82

FIG. 83



case	C,D	E,F	G,H	ai	bi	ci	di	ei	fi	gi	hi
1a	$\pm 1,0$	1,0	1,0	$\pm S$	0	$\pm AS$	0	$\pm S$	$\pm BS$	0	0
1b	0, $\pm 1$	1,0	1,0	0	$\pm(-S)$	$\pm(-BS)$	$\pm S$	0	$\pm AS$	0	0
1c	C,D	1,0	1,0	CS	-DS	Aai+Bbi	DS	CS	BS	0	0
2a	$\pm 1,0$	E,F	1,0	$\pm S$	0	$\pm AS$	0	$\pm ES$	Bei	0	$\pm FJ$
2b	0, $\pm 1$	E,F	1,0	0	$\pm(-S)$	$\pm(-BS)$	$\pm ES$	0	Adi	$\pm FJ$	0
2c	C,D	E,F	1,0	CS	-DS	Aai+Bbi	DES	CES	Adi+Bei	DFJ	CFJ
3a	$\pm 1,0$	1,0	G,H	$\pm GS$	0	Aai	0	$\pm S$	$\pm BS$	$\pm(-HJ)$	0
3b	0, $\pm 1$	1,0	G,H	0	$\pm(-GS)$	Bbi	$\pm S$	0	$\pm AS$	0	$\pm HJ$
3c	C,D	1,0	G,H	CGS	-DGS	Aai+Bbi	DS	CS	Adi+Bei	-CHJ	DHJ
4a	$\pm 1,0$	E,F	G,H	$\pm GS$	$\pm FHS$	Aai+Bbi	0	$\pm ES$	Bei	$\pm(-HJ)$	$\pm FGJ$
4b	0, $\pm 1$	E,F	G,H	$\pm FHS$	$\pm(-GS)$	Aai+Bbi	$\pm ES$	0	Adi	$\pm FGJ$	$\pm HJ$
4c	C,D	E,F	G,H	CGS+ DFHS	-DGS+ CFHS	Aai+Bbi	DES	CES	Adi+Bei	-CHJ+ DFGJ	DHJ+ CFGJ

FIG. 85

FIG. 86

FIG. 86



